PROFITABILITY OF SMALLHOLDER SUGARCANE FARMING SYSTEMS IN TANZANIA: A COMPARATIVE ANALYSIS BETWEEN BLOCK FARMING AND TRADITIONAL FARMING SYSTEMS IN MOROGORO

ALLY SHABANI MUSHI

A THESIS SUBMITTED IN FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF DOCTOR OF PHILOSOPHY OF THE OPEN UNIVERSITY OF TANZANIA

2015

CERTIFICATION

The undersigned certifies that he has read and hereby recommends for presentation to the Senate of the Open University of Tanzania a thesis titled: **Profitability of Smallholder Sugarcane Farming Systems in Tanzania: A Comparative Analysis between Block Farming and Traditional Farming Systems in Morogoro** In fulfilment of the requirements for the award of the degree of Doctor of Philosophy of the Open University of Tanzania.

………………………

Professor Deus Ngaruko

(Supervisor)

Date………………………………

COPYRIGHT

DECLARATION

I **Ally Shabani Mushi**, declare that this research is my own original work and that it has not been presented and will not be presented to any other university or higher institution of learning for a degree or any other similar award.

Signature …………………………………………………..

DEDICATION

I dedicate this research work to my late mother Fatuma Ally, and my late father Shabani Mushi; May the almighty God rest their souls in eternal peace!

ACKNOWLEDGEMENT

First and foremost I thank the Almighty God for enabling me to conduct and complete this study timely. Sincere thanks are expressed to my entire family for all their understanding, patience, and support during the period of my study; indeed their support will be honoured forever. Professor Deus Ngaruko, my research supervisor, deserves a very special and sincere gratitude for his scholarly guidance which enabled this work to be successful. My sincere gratitude goes also to all sugarcane growers and officials of various Block Farms at Kilombero who accepted to fill my questionnaires and returned the forms timely. Mrs Hadija Himiri, Mr John Mlowezi and Mrs Genesia Male deserve my sincere thanks for availing to me various reports and data on outgrowers. I am also indebted to the Kilombero Sugar Company (KSC) Outgrowers Services Manager, Mr Zabdiel Msechu, for his positive comment that facilitates my access to data at KSC. Likewise my gratitude goes to the KSC Directorate of Finance, Mr Grant Mapharn, for allowing me access to data in his department. NMB bank officials- Kilombero branch as well as SACCOs officials who availed to me a number of data on smallholder sugarcane farmers' loan deserves my sincere gratitude. I am indeed heavily indebted to Mrs Sarah Mloka, Mr Kalua Nyomolelo and Mr Hassan Lusewa for their tireless efforts to distribute and collect the questionnaires. Last but not least in importance, I thank Dr. Salum Mohamed for arranging PhD seminar presentation and Professor Jan-Erik Jaensson, Dr. Gwahula Rafael and Dr. Hawa Uiso for their very valuable comments during the PhD seminar presentation.

ABSTRACT

There is circumstantial evidence that smallholder sugarcane farming systems have substantial effect on the profitability of smallholder farmers. Primary data collected through semi structured questionnaires administered to a random sample of smallholder sugarcane farmers in Morogoro region were analysed by T-Tests, One way ANOVA, Tobit regression and Spearman's rank correlation tests all at $p = 0.05$ to comparatively assess differences and effects of hypothesized factors on profitability between Block Farming System (BFS) and Traditional Farming System (TFS). The effect of profitability of the farming systems on loan repayment rate (LRR) has also been analysed. BFS appears to be significantly more effective than TFS on both profitability and loan repayments. Profitability, expressed as a ratio of operating income to revenue, is significantly higher by 17% in BFS ($M = 0.56$) than profitability achieved through TFS ($M = 0.39$). Yield, price and cost have significant effects on profitability of both BFS and TFS. Effects of land size and sucrose were found not to be significant on BFS but significant on TFS. Correlation between profitability and LRR is significantly high on both BFS, $r\ (7) = 0.84$, $p = 0.04$, and TFS, $r\ (68) = 0.79$, $p < 0.0001$. LRR through BFS ($M = 0.96$) is significantly higher by 20% than LRR through TFS ($M = 0.76$). Reviews of the Agriculture and Livestock Policy and the Microfinance Policy are recommended. Generic model, FSP-M has been developed and recommended for future studies of profitability. Studies on how sucrose content is measured and its relation to sugarcane price setting is suggested. Also studies on factors affecting loan repayments among smallholder farmers as well as on institutional effects of microfinance institutions on loan repayment are recommended.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

BF : Block Farming

BFS : Block Farming System

Ha/ha : Hectare

K1 : Kilombero 1

K2 : Kilombero 2

KCT : Kilombero Community Trust

KCCT : Kilombero Charitable Community Trust

KSC : Kilombero Sugar Company Limited

LRR : Loan Repayment Rate

MCP : Miller cum Planters

SBT : Sugar Board of Tanzania

TF : Traditional Farming

TFS : Traditional Farming System

URT : United Republic of Tanzania

CHAPTER ONE

INTRODUCTION

1.1 Background Information

Smallholder Sugarcane Block Farming System (BFS) is a new farming strategy introduced in Tanzania in 2006 to replace/complement on the inefficiently perceived Traditional Farming System (TFS). BFS is defined as a contiguous farming area operated under shared ownership that allows small, otherwise economically inefficient farmers to take advantage of economies of scale via the collective management of various inputs, and via overcoming the obstacles of fixed costs per unit of necessary infrastructure investments (Rugaimukamu et.al, 2007; Basimwaki, 2007). Block farms are expected to have the characteristics of large scale farming in which farmers can efficiently utilize capital, machinery and labour and also obtain discount from purchase of large volumes of inputs, (Ken & Paulson, 2011).

Large scale farming can be done in various ways, like collective farming, state farming, corporate farming, and cooperative farming. The cooperative farming societies are again of various types like joint farming or better farming. The joint farming societies are those where members retain the ownership of the land, but cultivation on the land is done collectively, (Madan, 2007).

Collective farming society undertakes joint cultivation for which all its members pool their labour resources and each receives in return prescribed wages. Large-scale cultivation facilitates mechanization of agricultural production and this is the society's most important gain. The profits are worked out at the end of the year, after deducting wages, cost of management and allotment to reserves and divided in proportion to the wages earned by each member, (Madan, 2007).

Block Farming System which have the characteristics of both joint farming and collective farming societies were introduced in Tanzania through a European Union grant amounting to €562,000 aiming to improve the productivity of smallholder sugarcane farmers in five areas namely, Kilombero and Mtibwa in Morogoro region, Kagera in Kagera region, Mahonda in Zanzibar and TPC in Kilimanjaro region, (European Commission, 2006). The first block farms in the country were formed in Kilombero valley within the Morogoro region in 2006. About 15 to 35 contract smallholder farmers whose farms are sharing borders join their small farms with size less than 0.4 to 2.02 hectares to form one homogeneous block farm with size ranging from 20 to 30 hectares.

Contract sugarcane farmers, 85% of them being smallholders, supply about 50% of all sugarcane required by the sugar processing factories in Tanzania, (Magambo, 2008). About 5% of the smallholder sugarcane farmers are practicing Block Farming and the remaining 95% are engaged in the Traditional Farming. According to Logsdon (2000), traditional farms have several characteristics by which they are known, but above them all hangs a general characteristic in which all traditional practices find their rationale. The traditional farm can survive a series of crisis. However, it can suffer from a principle basic to any biological system: leave out one strand of the fabric of traditional farm and the whole system flatters. Major expectation of the smallholder farmers is to improve their welfare by maximizing their profits through commercial farming operations.

"Kilimo Kwanza" initiative calls for a transformation of smallholder farmers into commercial farmers. Among strategies to achieve the vision of this initiative is development of clusters of commercial farms in areas where there is high agricultural potentials. The approach involves providing support to the commercial farmers to encourage development of profitable cluster of farms and ensure direct benefits to smallholder farmers, (SAGCOT, 2014).

According to Hazlitt, (2013), profits let commercial entities know whether it is worth producing a product. Theoretically in free and competitive markets, maximizing profits ensures that resources are not wasted. In the neoclassical theory of the firm, the main objective of a business entity is profit maximization. Basing on the Adam Smith's Wealth of Nations, the promise of greater profits provide a powerful motivation for change. Profitability is the ratio of the gross margin (gross profit) to the revenue.

Hazlitt, (2013) reported that the essence of profitability is a firms revenue, whereas costs with revenue depends upon price and quantity of the good sold. Looking at smallholder farms as economic entities, price of produces is also dependent on quality of crops whereas the quantity of goods sold is dependent on production yields. Size of farms is crucial when it comes to benefits of economies of scale expected from appropriate management of various inputs as well as through overcoming the obstacles of fixed cost per unit of necessary infrastructural investments. The profitability of a commercial entity like sugarcane farming depends also on effective coordination of various factors key into generating and enhancing sustainable profit from the farming operations.

Actor Network Theory (ANT) and Luhmann's theory of social system understands a farm enterprise as a self-organizing system, and thereby as a system independent of an external observer, Noe & Alroe, (2012). From the point of view of general system theory, there are three main theories of coordination namely, hierarchies (full ownership integration), markets (open market integration) and networks (cooperative and corporate coordination), Rehber, (2006). The hierarchies' coordination theory is widely practiced in sugarcane, cotton and tobacco crop subsectors in Tanzania through contract Traditional Farming system. The application of networks theory of coordination in Tanzania have been put in practice to smallholder farmers in 2006 when Block Farming system was introduced in the sugarcane crop industry. The current study intends to comparatively assess the profitability of the Block Farming system which is based on the network theory of coordination and the profitability of the Traditional Farming system which is based on the hierarchies' coordination theory.

The study by Mushi (2012) on the performance of Block Farming system on sugarcane production from 2007 to 2011 had revealed a significant improvement on the sugarcane production by smallholder farmers at the Kilombero valley. The average sugarcane yield in block farms was found to be 65.14 tons of cane per hectare, whereas the traditional farmers had realized an average yield of 45.26 tons of cane per hectare. However, despite of significant improvement on sugar yield due to block farming system, there was a concern among smallholder farmers that the cost of production in block farms is on the higher side and thus affects the profit of the farmers. Profitability arising from the farming operations is also crucial to ensure that the farmers are credit worth and able to reimburse their loans effectively.

1.2 Statement of the Problem

The introduction of Block Farming System in Tanzania has resulted in a significant increase on the sugarcane yield per hectare. Block Farming system has increased the sugarcane production by smallholder farmers to an average of 65.14 tonnes of cane per hectare as compared to 45.26 tonnes of cane per hectare achieved by the traditional farmers. However, despite this significant increase in sugarcane production, smallholder farmers have opinion that production costs in block farms is high and it affects their profitability. They argue that despite higher yields obtained in block farms, individualized Traditional Farming System is better than Block Farming System in terms of profitability. Profitability realized through the farming systems is also crucial into ensuring that the smallholder farmers are able to repay their loans effectively. It is therefore, imperative to critically examine the profitability of the smallholder sugarcane farming systems in Tanzania through a comparative analysis between Block Farming and the Traditional Farming systems.

1.3 Objectives of the Study

The general objective of this research is to assess the effectiveness of Block Farming and Traditional Farming Systems on the profitability of sugarcane farming by smallholder farmers in Tanzania. Specifically the study intends to:

i. Identify profitability factors for smallholder sugarcane farmers practising Block Farming system and Traditional Farming system,

ii. Examine determinants of profitability of smallholder sugarcane farming through Block Farming system in comparison to Traditional Farming system, and,

iii. Assess the effect of the profitability of the Block Farming and Traditional Systems on loan repayment performance.

1.4 Research Hypotheses

This study will be governed by the following sets of hypotheses based on the three specific objectives:

i. H0 (null hypothesis): There are no significant differences on the factors affecting the profitability of smallholder sugarcane farming system between Block Farming and Traditional Farming.

   H1 (alternative hypothesis): There are significant differences on the factors affecting the profitability of smallholder sugarcane farming systems between Block Farming and Traditional Farming.

ii. H0: Block Farming system is not more effective than Traditional Farming system into ensuring profitability of smallholder sugarcane farmers.

   H1**:** Block Farming system is more effective than Traditional Farming into ensuring profitability of smallholder sugarcane farmers.

iii. H0**:** There are no significant differences on the effects of the profitability of the Block Farming and Traditional Farming systems on loan repayment performance.

   H1**:** There are significant differences on the effects of the profitability of the Block Farming and Traditional Farming systems on loan repayment performance.

1.5 Significance of the Study

The outcome of this study is expected to provide an insight on the effectiveness of Block Farming System (BFS) in comparison to Traditional Farming System (TFS) on the profitability of smallholder sugarcane farmers. This will eventually enable various stakeholders including policy makers, to make informed decisions and formulate or amend relevant policies that will facilitate enhancement of an appropriate farming system between BFS and TFS as a system of choice to all smallholder farmers in Tanzania. The study is also expected to form basis for future studies on profitability or economic performance of smallholder farming systems.

1.6 Organisation of the Thesis

This thesis is organised in five chapters. The first chapter discusses the background of the study. The chapter also presents the statement of the problem, research objectives, research hypothesis and significance of the study. Chapter two presents reviews of literatures, theories and conceptual definition relating to the study. Identified research gap, theoretical framework, conceptual framework and expected contributions to knowledge and understanding are also presented in the second chapter. Chapter three presents the research methodology used in the study. Research findings and discussions of the results are presented in chapter four. In chapter five conclusions and recommendations of the study are presented. The chapter also presents contributions to knowledge and understandings. The manuscript is finalized by presentations of various references used in the study as well as a section on appendices.

CHAPTER TWO

LITERATURE REVIEW

2.1 Chapter Overview

This chapter inhabits on the review of various literatures relating to the current study. The chapter presents conceptual definitions and various theories relating to the study. Critical reviews of theoretical and empirical literatures as well as review of relevant policies have been made. Reviews of methods used in other relevant studies have also been made. A summary of the reviewed literatures is also presented. The identified research gap, theoretical framework, conceptual framework and expected contribution to knowledge and understanding from the outcome of the study have also been presented in this second chapter of the manuscript on the profitability of smallholder farming systems in Tanzania through comparative analysis between Block Farming System and Traditional Farming System.

2.2 Conceptual Definitions

2.2.1 Conceptual Definition of Profitability

Profitability is the primary goal of all business ventures. It is the ability of a business to earn a profit. A profit is what is left of the revenue a business generate after it pays all expenses directly related to the generation of the revenue, such as producing a product, and other expenses related to the conduct of the business' activity. According to Hofstrand, (2013) profitability can be defined as either accounting profits or economic profits. Traditionally, accounting profits have been used to compute farm profits. Accounting profits provide an immediate view of the viability of a business. In this study, profitability is viewed as an essential and necessary requirement for sustainable smallholder sugarcane farming. Through the profitability of the sugarcane farming systems, smallholder farmers are also expected to repay their loan timely and effectively.

2.2.2 Conceptual Definitions of Variables relating to Profitability

Horngren et al. (2009) wrote that profit margin is the amount of income earned on every dollar of sales. It is a component of Return on Investment (ROI). In this study of the profitability of smallholder sugarcane farming systems through comparative analysis between Block Farming and Traditional Farming systems, operating profit margin (Equation 1) is looked at as an indicator of profitability. Here profitability of the smallholder sugarcane farmers will be explained by the operating profit margin.

Arnold (2008) mentioned that operating profit also known as EBIT is found on the company's income statement. EBIT is a Company's earnings (profits) before interest and tax are deducted. The operating profit margin looks at earnings before interest and tax (EBIT) as a percentage of sales by way of Equations 1 and 2 as presented in Investopedia, (2011):

$$\text{Profitability} = \text{Operating profit margin} = \text{EBIT} \div \text{Net sales} \quad \text{……………….... (1)}$$

Whereas,

$$\text{EBIT} = (\text{Gross profit} - \text{Operating expenses}) \quad \text{……………..……………..……. (2)}$$

It was reported in Investopedia (2011) that operating profit margin is a rough measure of the operating leverage a company can achieve in the conduct of the operational part of its business. It indicates how much EBIT (its calculation is shown in Equation 2) is generated per shilling of sales. High operating profits can mean the company has effective control of costs, or that sales are increasing faster than operating costs.

Gross profit (gross margin) is net sale minus the cost of goods sold. Merchandisers strive to increase the gross profit percentage, which is computed as follows:

$$\text{Gross profit percentage} = \text{Gross profit } \div \text{Net sales revenue} \ldots\ldots\ldots\ldots\ldots\ldots \text{.... (3)}$$

The gross profit percentage (Equation 3) is one of the most carefully watched measures of profitability. A small increase may signal an important rise in income. Conversely, a small decrease may signal trouble, (Horngren et al, 2009).

2.2.3 Conceptual Definitions of Farming Systems

Farming system is defined as a population of individual farm systems that have broadly similar resources bases, enterprise patterns, household livelihoods and constraints, and for which similar development strategies and interventions would be appropriate, Dixon et al., (2001). The terms farm systems and farming systems are often used interchangeably. The common practice is to use farm system to refer to structural of an individual farm and farming system to refer to broadly similar farm types in specific geographical areas or recommendation domains.

2.2.4 Conceptual Definition of Loan Repayment

Loan repayment can simply be defined as the rate of the amount of loan repaid in comparison to the total amount of loan acquired. The loan repayment ratio measures how much of a loan an average borrower is required to pay. It is defined the ratio of the required repayments to loan size received, both measured in terms of present values, (Shen & Ziderman, 2008). Profitability is considered an important determinant of loan repayment by the smallholder farmers. In the current study of the profitability of the smallholder sugarcane farming system in Tanzania, the correlation between profitability of the smallholder farming systems (Block Farming and Traditional farming) and loan repayment will be examined.

2.2.5 Effective and Effectiveness Defined

According to Harper, (2011), the origin of the word effective stems from the Latin word 'effectivus', which means creative or productive. Effectiveness is the capability of producing desired result. Something is said to be effective if it has an intended or expected outcome, or produces a deep, vivid impression.

2.3 Theoretical Literature Review

2.3.1 Theories of Profit

According to Dwivedi, (2008) many profit theories have been put forward by different economist. One of this theory is the dynamic theory which posits that profit accrues because the society is dynamic in nature. Since the dynamic nature of society makes future uncertain and any act, the result of which has to come in future, involves risk. The profit is the price of risk taking and risk bearing. Also profit is a result of an adjustment, which is brought by the entrepreneurs themselves. They may find new techniques of production and reduces the cost of production.

Another theory is the marginal productivity theory of profit in which the profit always equals the marginal productivity of the entrepreneur. This theory posits that the profit depends upon the marginal production. The greater the marginal production greater will be the profit. Wages theory of profit is a theory which classifies the services of entrepreneur as labor however of superior type. These entrepreneurs do a lot of work in organizing the business unit as well.Profit is a wage for the entreprenuer for the services rendered by them. Another theory of profit was put forward by Profesor Knight who posits that profit is the reward for uncertainty bearing and risk taking. Profesor Knight has regarded uncertainty bearing as a factor of production, (Dwivedi, 2008).

Mainstream microeconomic theory posits that the ultimate goal of a business is to make money. Stated differently, the reasons for a business' existence is to turn a profit. Accordingly, business seek to benefit themselves and/or shareholders by maximizing profit. In neoclassical microeconomic theory, profit is either of two but distinct concepts viz. economic profit and accounting profit. Economic profit is similar to accounting profit but smaller because it deducts of the total the opportunity costs (inclusive of explicit and implicit costs) of a venture to an investor. Normal profit refers to zero economic profit, (Carbaugh, 2006).

2.3.2 Profitability Models

Classic microeconomic theory suggests profitability can be modelled through a 'Marginal-Revenue-Marginal-Cost 'approach. The means of determining the behaviour, including viability of 'for–profit' competitive entities to calculate and compare at each price level amounts that each additional unit of output would add to total revenue on the one hand, and the total cost on the other hand (Jackson & McConnell, 1980).

2.3.3 Concepts of Profitability of Farming Systems

The concept of profitability of farming systems can be explained as the margin between revenues realized from sale of produce, termed gross output, and total variable cost of production. The term gross margin is reserved for the estimate and the basic unit is Shillings per hectare. It is the balance that when accumulated from all hectares of the entire crop grown on the farm provides the balance out of which the farm overhead costs are paid. Nemes (2009) reported that meanings of profitability could be as many as the number of researchers conducting studies on profitability.

Nemes (2009), cited Offermann and Nieberg (2000) who reported that profit is generally one of the most common and accepted indicators for the success of an economic activity. However, the definitions for profit differ between countries and studies, which make the comparability of profitability calculations between countries even more challenging. The meaning of profitability, as well as the different methodologies used for such studies, varies according to the different objectives of these studies.

2.3.4 Theories and Concepts of Farming Systems

A theoretical concept combining the Actor Network Theory (ANT) and Luhmann's theory of social system was developed as a working ontology that understands a farm enterprise as a self-organizing system, and thereby as a system independent of an external observer. Whereas the Actor Network Theory focuses on heterogeneous openness between the entities of the social, biological and technical domains of the world, Luhmann takes the opposite position in his theory of social systems where he focuses on the operational closure necessary for any system to operate itself and thereby claims that all autopoietics systems are self-referential, (Luhmann, 1995). Luhmann's system theory makes it possible to observe and understand a farm management system as a self-referential social system that selects its own schema of differences, defends its logic, values and meaningfulness, (Noe & Alroe, 2012).

2.3.5 The Cost Theory of Value and its Relevance in Farms

According to Murphy, (2011), the cost theory of value explains the final price of good or service by how much it cost to produce it. In economics, the cost-of-production theory of value provides that the price of an object or conditions is determined by the sum of cost of the resources that went into making it. The cost can comprise of the factors of production (including labour, capital or land) and taxation. The theory makes the most sense under the assumption of constant return to scale and the existence of just one-non produced factor of production. Under the assumption of the non-substitution theorem, the long-run price of a commodity is equal to the sum of the cost of the inputs into that commodity, including interest charges, (Kuga, 2001).

Tham & Fox, (2004) asserted that if profits are to be realized, companies need to closely examine their current cost management practices towards profitability. According to Tham et al., (1994) cost is that entity which represents the temporal fiscal or monetary dimension, attribute, or characteristic of an enterprise activity, and may be referred to as activity cost.

Nemes (2009) re-counted that in economics, fixed costs are business expenses that are not dependent on the activities of the business. They tend to be time-related, such as salaries or rents. Nemes (2009) also cited Sullivan and Sheffrin (2003) who said that by contrast, variable costs are volume-related. By definition, fixed costs are part of the total farm costs that do not vary significantly with the volume of output and that can only be changed in the long run, whereas variable costs are those that vary directly with the volume of output.

The differentiation between variable and fixed costs is actually only important when gross margins are calculated since for those, fixed costs are not accounted for. However, fixed costs are crucial for farm profitability. Even though most studies make the distinction between the two types of costs, they may not specify exactly what costs are included among them. Mentioning merely variable and fixed costs does not allow the appreciation of the variables used and thus, proper comparison, (Nemes, 2009).

In this study of the profitability of the smallholder sugarcane farming systems in Tanzania through a comparative analysis between Block Farming and Traditional Farming systems, both variable costs and fixed costs have been looked into. Basically the land preparation costs and costs of infrastructures form the fixed cost element whereas other operational costs like seed cane, planting, weeding, fertilizing, and herbicide applications forms variable cost element. The total production cost comprising of fixed costs and variable costs have been used in the examination of the determinants of the profitability of the two farming systems. Transport cost, cess, contributions, fees, supervisions costs have been charged as operating expenses and used in the calculation of the operating profit or earnings before interest and tax (EBIT).

2.3.6 Comparative Analysis of Profitability of Farming Systems

Nemes (2009) asserted that, when there is a difference between two production systems, it is important to determine whether these differences are because of the system itself or are due to external factors such as management skills of farmers. Whether a farming system is profitable depends also on what is included in the analysis. Nemes (2009) said that it is very difficult to measure off-farm effects though they are extremely relevant for determining the efficiencies of a particular farming system. Failure to choose the right comparative groups by accounting for the non-system determined factors may lead to the question whether these or the type of production system is responsible for differences in profitability.

Nemes, (2009) cited Cisilino and Madau (2008) who mentioned that comparisons can be made between different groups categorized as: groups of similar farms; between two representative farms; between farms based on minimum similar criterion; or between farms with similar characteristics in production system, size and location. However, Nemes, (2009) asserted that it is generally difficult to conclude that one system is more profitable than the other.

2.3.7 Theory and Concepts of Loans and Reasons for Borrowing

Loan portfolios have existed since the early days of commercial banking in response to theories of bank liquidity management. Four different theories of liquidity namely, the commercial-loan theory, the shiftability theory, the anticipated income theory and the liability management theory can be identified. The commercial-loan theory is also referred to as real bills doctrine. Banks' lending to merchants traditionally took the form of discounting commercial bills. The discounting of bills was viewed as a safe and liquid loan practice backed by the goods involved in the transaction and the forthcoming sale of which would generate the proceeds to pay off the bank, Roussakis, (1997).

According to Roussakis, (1997), the shiftability theory considers the marketability of an asset to be the main source of liquidity, and hence to be the qualifying attribute for its acquisition by a bank. The anticipated–income theory argues that a bank can maintain its liquidity if loan repayments are scheduled on the basis of the anticipated income of borrower rather than the use made of the funds or the collateral offered.

Kohn (2005), stated that, while trade in goods and services may or may not involve promises, lending always does. A lender gives up purchasing power today in exchange for a promise of purchasing power tomorrow. The basic problem is that the promise may not be kept as there is a risk of default from borrower. However, the risk of default need not discourage lenders from lending.

Kohn (2005) asserted that all businesses make significant outlays before they see any revenue. This is true even after a business has started. Revenue coming in pays for past production, but there are always new expenses before they can sell their product. The funds required for financing the current expenses of producing and selling a product or service are known as working capital. The need for working capital is one reason why businesses borrow. On the other hand, production often requires long term investment in equipment and facilities. The resources required are known as fixed capital. The need for fixed capital is the second reason businesses borrow.

Rutgers (2011), reported that farmers often take short or long-term loans to pay for supplies, labour and inputs. To account for these, it is suggested that interest on operation capital is included as a cost of production charged on total variable costs at a rate per annum. For annual crops, interest can be calculated for the growing period till the harvest, and for perennial crops, for the full year.

2.4 Empirical Literatures Reviews

2.4.1 Sugarcane Farming Profitability in Africa

It was reported by Masuku, (2011) and Dlamini & Masuku, (2013) from their studies on the determinants of profitability for smallholder sugarcane farmers in Swaziland that profitability of the sugarcane farmers was affected by the yield per hectare, the farmer's experience, sucrose content in the sugarcane, the change in the production quota of the farmers and the distance between the farm and the mill. The study suggested that smallholder farmers need to be trained and motivated in order to be commercially oriented and improve yield.

In the study by Waswa et al (2011) to establish the relationship between contract sugarcane farming, poverty and environmental management in the Lake Victoria basin, results from Lurambi, Koyonzo and Chemelil showed that on average farmers retained only 32, 31 and 34% respectively of the gross income from contract sugarcane farming. The study suggested that to profit from contract sugarcane farming, farmers need to at least double their current mean yields per unit area, assuming that available land devoted to sugarcane excluding land for subsistence farming is at least 5 acres.

Findings reported by Mbuyazwe & Barnabas, (2012) from their study to determine explanatory variables for sugarcane yield among small, medium and large scale growers at Ubombo Sugar, Swaziland, indicated that large scale farmers obtained significantly higher yields than small scale farmers. However, they found that sucrose percentage was higher with small scale farmers than medium and large scale farmers.They also found that distance between the farm and the mill had a significantly negative effect on sugarcane yield.

In the study to examine the profitability of smallholder out-grower tea farming and its determinants in Chipinge district of Zimbabwe, Lighton et al., (2014) found that major determinants of profitability among the smallholder farmers are yield per hectare and area under tea production. The data from the study were analyzed using descriptive statistics, gross margin analysis and multiple regression model.

2.4.2 Factors of Farm Profitability

Ken and Paulson, (2011) reported that farm size affect profitability due to a number of factors, including intricacies of management decisions by farm operators. They mentioned that profitability in large farms may be enhanced due to increasing return to scale or by growing the scale of operations. They also mentioned that large farms may be able to more proficiently use larger equipment complements and obtain rebates by buying larger volumes of inputs.

According to the Directorate General for Agricultural, (2000) report, to majority of farmers (50 to 75%), increase in yield of various crops is a key factor for profitability expectations and results. Effect of cost on profitability has been mentioned to be second to yield. Another important factor on result side is market price. Due to this reasons, there has been quick rate of adoption of genetically modified crops (GMC). However, the report mentioned that yield performance between genetically modified crops and non-genetically modified crops is mainly dependent on growth conditions.

2.4.3 Sugarcane Farmers Loan Repayment

Sileshi et al. (2012) examined the determinants of loan repayment performance among smallholder farmers in East Hararghe zone, Ethiopia. The study revealed that there is a serious loan repayment delinquency in the study area with 71.4 percent of borrowers being partial defaulters. The results of the regression analysis at $p < 0.05$ showed that agro ecological zone, off-farm activity and technical assistance from extension agents positively influenced the loan repayment performance of smallholder farmers, while production loss, informal credit, social festival and loan-to-income ratio negatively influenced the loan repayment of smallholder farmers.

A study by Acquah and Addo, (2011) has found that there was a 70.1 percent loan repayment delay among fishermen in Ghana. Another study by Magali, (2013) on factors affecting credit defaults risks for rural savings and cooperative societies in Tanzania have revealed that there is 22% loan repayment default rate among Tanzanian borrowers with 15% caused by male borrowers and 7% from female borrowers.

Victor (2012), studied determinants of loan repayment default among farmers in Ghana. The results indicated that farm size, and engagement in off-farm income generating activities reduces the likelihood of loan repayment default significantly. Also, larger loan amount and longer repayment period as well as access to training are more likely to reduce loan repayment default. They recommended that policy that aimed at improving farm sizes, farm income and cultivation of cash crops would significantly reduce loan repayment default. In addition, loan repayment default would reduce if lenders train their loan beneficiaries and offer them adequate amount of loan and longer repayment period.

In the study by Adegbite (2009) to assess the repayment performance of loan beneficiaries under the Ogun State Agricultural and Multipurpose Credit Agency, the empirical results revealed that the average volume of loan disbursed gave an overall Repayment Performance Index (RPI) of 0.57. Loan volume disbursed, disbursement lag, farm location, age, farming experience and education affected repayment by beneficiaries and were significant at $p = 0.05$. The mean age, farming experience, disbursement lag, farm location and farm size were found to be 43.3 years, 20.5 years, 15.4 weeks, 17.6 km and 2.3 hectares respectively. Reasons given include incidence of flood, pests and diseases, low and untimely loan volume disbursed and distance to the credit office.

A study by Oni et al. (2005) has found that flock size is a major factor that significantly influence default in loan repayment by farmers. Interest rate was found to influence loan repayment default negatively but not significantly. The study also found that loan size which has positive sign did not have significant effect on loan repayment default. Education level of farmers was found to have significant effect in the default of loan repayment.

Study by Koopahi & Bakhshi (2002) to identify defaulter farmers from non-defaulters of agricultural bank recipients in Iran showed that use of machinery, length of repayment period, bank supervision on the use of loan had significant and positive effect on the agricultural credit repayment performance. In the other hand incidence of natural disasters, higher level of education of the loan recipient and length of waiting time for loan reception had a significant and negative effect on dependent variable. This study intends to focus on the examination of the effects of profitability of the smallholder farming systems on loan repayment performance.

It was found by Ayanda & Ogunsekan (2012) that a significant and inverse relationship exist between interest rate (r = - 0.151, p < 0.05) and loan repayment. They asserted that higher interest rates lead to lower capacity of the farmers to repay loans. They also mentioned that interest amount will take a larger part of return on investment and thus weaken the farmers' ability to repay loans. They have also reported that an increase in the size of the farmland leads to a higher level of income due to increased production and hence results into a higher potential to repay loans.

2.4.4 Summary of the Reviewed Empirical Literatures in Tabular Form

Author	**Year**	**Country of Study**	**Findings Reported**
Masuku; Dlamini & Masuku	2011 2013	Swaziland	Profitability of sugarcane farmers were affected by yield and sucrose.
Waswa et al.	2011	Kenya	Farmers in Lurambi, Koyonzo and Chemelil retained 31, 32 and 34% of gross margin.
Lighton et al.	2014	Zimbabwe	Yield per hectare and area under cultivation were major determinant of profitability.
Ken & Paulson	2011	Illinois, USA	➢ Farmer's profitability enhanced by increasing return to scale or expanding scale of operations. ➢ Large farm may use large equipment more efficiently and obtain discount by buying large volumes of inputs.

Mbuyanzwe & Barnabas	2012	Swaziland	Large scale farmers attained higher yield than small scale farmers, but Small scale farmers achieved higher sucrose content than medium and large scale farmers.
Directorate General for Agriculture	2000	EU	Yield, cost and market price are key determinants of farmers' profitability expectations.
Sileshi et al.	2013	Ethiopia	Reported serious loan repayment delinquency (71.4% of borrowers were partial defaulters).
Acquah & Addo	2011	Ghana	Reported 70.1% loan repayment delay.
Magali, J.	2013	Tanzania	Reported 22% loan repayment default.
Victor, D.	2012	Ghana	Reported that farm size, large loans and off farm income generating activities reduced likelihood of loan repayment default.
Ayanda & Ogunsekan	2012	Nigeria	Interest rate and loan repayment have significant inverse relationship.
Adegbite, D.	2009	Nigeria	➢ Reported overall repayment performance index of 0.57 in Ogun state. ➢ Loan volume, farm location and farmers experience affected loan repayment.
Oni et al.	2005	Nigeria	➢ Flock size influenced default in loan repayment. ➢ Interest rate affected loan repayment negatively.

2.5 Analytical Methods Used in Various Studies

Various analytical methods were used in various studies of sugarcane profitability and loan repayment performance respectively. These methods include multiple regression models such as ordinary least squares method (OLS), Logit, Tobit and Probit models, respectively. Also, t- Test and ANOVA were used in various studies, (Adegbite, 2009; Masuku, 2011; Waswa et al. 2011; Sileshi, 2012; Victor, 2012). These processes are elaborated below to enable an appropriate choice of the ones to be used in this study.

2.5.1 Logistic and OLS Regression Compared

Logistic regression also called Logit model is an approach to prediction, like Ordinary Least Squares (OLS) regression, (Amemiya, 1985). However, with logistic regression, the researcher is predicting a dichotomous outcome. This situation poses problems for the assumptions of OLS that the error variances (residuals) are normally distributed. Instead, they are more likely to follow a logistic distribution.

When using the logistic distribution, we need to make an algebraic conversion to arrive at the usual linear regression Equation 4 which is written as:

$$Y = \beta_0 + \beta_1 X + \varepsilon \quad \ldots\ldots \quad (4)$$

With logistic regression Equation 5, there is no standardized solution printed. And to make things more complicated, the unstandardized solution does not have the same straight-forward interpretation as it does with OLS regression model, (Amemiya, 1985; Greene, 2000):

$$\text{logit}\,(\rho_i) = \ln\{\frac{\rho}{1-\rho}\} = \beta X_i \quad \ldots\ldots \quad (5)$$

Where ρ is the probability that Y =1, and (1 - ρ) represent the probability that Y = 0

One other difference between OLS and logistic regression is that there is no R^2 to gauge the variance accounted for in the overall model. Instead, a chi-square test is used to indicate how well the logistic regression model fits the data. Because the dependent variable is not a continuous one, the goal of logistic regression is a bit different, since it predicts the likelihood that Y is equal to 1 (rather than 0) given certain values of X. That is, if X and Y have a positive linear relationship, the probability that a person will have a score of Y = 1 will increase as values of X increase, (Amemiya, 1985; Greene, 2000).

Long (1997) asserted that when OLS regression is used with a binary response variable, it is known as a linear probability model and can be used as a way to describe conditional probabilities. However, the errors (residuals) from the linear probability model violate the homoscedasticity and normality of errors assumptions of OLS regression, resulting in invalid standard errors and hypothesis tests.

2.5.2 Probit Model

Referring to Amemiya (1979), a probit model is a popular specification for an ordinal or a binary response model. As such it treats the same set of problems as does by logistic regression using similar techniques. The probit model, which employs a probit link function, is most often estimated using the standard maximum likelihood procedure, such an estimation being called a probit regression. Suppose response variable Y is binary, that is it can have only two possible outcomes which we will denote as 1 and 0. For example Y may represent presence/absence of a certain condition, success/failure of some device, answer: yes/no on a survey.

We also have a vector of regressors X, which are assumed to influence the outcome Y. Specifically; we assume that the model takes the form shown in Equation 6, (Amemiya, 1979; Long 1997):

$\Pr(Y = 1|X) = \Phi(X\beta)$…………………………………………………….……. (6)

Where, Pr denotes probability and Φ is the Cumulative Distribution Function (CDF) of the standard normal distribution. The parameters β are typically estimated by maximum likelihood. It is also possible to motivate the probit model as a latent variable model. Suppose there is in existence an auxiliary random variable

$Y^{*}A = X^{1}\beta + \varepsilon$……………………………………….…………..……..…. (7)

Where, $\varepsilon \sim N(0, 1)$

Then Y can be viewed as an indicator for whether this latent variable is positive:

$$Y = \begin{cases} 1 \text{ if } Y^* > 0 & i.e. -\varepsilon < X^1\beta \\ 0 & \text{otherwise} \end{cases} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(8)}$$

As reported by Amemiya (1985), the use of the standard normal distribution causes no loss of generality compared with using an arbitrary mean and standard deviation because adding a fixed amount to the mean can be compensated by subtracting the same amount from the intercept, and multiplying the standard deviation by a fixed amount can be compensated by multiplying the weights by the same amount. To see that the two models are equivalent, note that:

$$\Pr(Y = 1|X = \Pr(Y^* > 0) = Pr(X^1\beta + \varepsilon > 0)$$

$$= \Pr(\varepsilon > -X^1\beta)$$

$$= \Pr(\varepsilon > X^1\beta)$$

$$= \Phi(X^1\beta) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(9)}$$

2.5.3 Limited Dependent Variables Model: Tobit Model

There are three types of regression models under the limited dependent variables models. These are Censored or Tobit regression, truncated regression and sample selected regression models. Inferring the characteristics of a population from a sample drawn from a restricted part of the population is known as truncation. A truncated distribution is the part of un-truncated distribution that is above or below some specified value (Greene, 2000); whereas, a sample in which information on the regressand is available only for some observation is known as censored sample. The use of Tobit models to study censored and limited dependent variables has become increasingly common in applied social science research for the past two decades, (Smith & Brame, 2003). Tobit is an extension of the probit model and it is one approach to dealing with the problem of censored data.

2.5.4 Specification of the Two-Limit Tobit Model

Amemiya (1985) asserted that the Tobit model is a statistical model proposed by James Tobin (1958) to describe the relationship between a non-negative dependent variable y_i and an independent variable x_i. The term Tobit was derived from Tobin's name by truncating and adding -it by analogy with the probit model. The model supposes that there is a latent (unobservable) variable y_i^*. This variable linearly depends on x_i via a parameter (vector) β which determines the relationship between the independent variable x_i and the latent variable y_i^*. (Just as in a linear model). In addition, there is a normally distributed error term ε_i to capture random influences on this relationship. The observable variable y_i is defined to be equal to the latent variable whenever the latent variable is above zero and zero otherwise:

$$y_i = \begin{cases} yi* \text{ if } yi* > 0 \\ 0 \text{ if } yi* \leq 0 \end{cases} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(10)}$$

Where, y_i^* is a latent variable given as:

$$y_i^* = \beta x_i + \varepsilon_i \,, \varepsilon \sim N(0, \sigma^2) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(11)}$$

y_i = the observed dependent variable,

y_i* = the latent variable (unobserved for values smaller than 0 and greater than 1).

x_i = is a vector of independent variables

β_i = Vector of unknown parameters

ε_i = Residuals that are independently and identically normally distributed with mean zero and a common variance σ^2, and i = 1, 2… n (n is the number of observations).

2.5.5 Interpretation of the Tobit Model

According to Amemiya (1979), the common error is to interpret the β coefficient as the effect of x_i on y_i as one would with a linear regression model. Amemiya reported that the β coefficient should instead be interpreted as the combination of the change in y_i of those above the limit, weighted by the probability of being above the limit; and the change in the probability of being above the limit, weighted by the expected value of y_i if above the limit. The two-limit Tobit model was originally presented by Rosett & Nelson (1975) and discussed in detail by Madalla (1992).

2.5.6 Adopted Analytical Methods for the Current Study

The analysis of the profitability of the smallholder sugarcane farming system have adopted the use various analytical methods including t-Test, one way analysis of variance (ANOVA) and correlations tests. The two limits Tobit regression model has been used to assess the causality of hypothesized factor on profitability. However, unlike in many studies where categorical data were used, the current study will use continuous ratio data. The adopted methods will fit well with the intention to conduct a quantitative analysis of the collected data.

2.6 Policy Review

The Agriculture and Livestock Policy, (URT, 1997) provides that the ultimate goal of the policy is the improvement of the wellbeing of the people whose principal occupation and way of life is based on agriculture. Most of these people are smallholder farmers who do not produce surplus. However the review of the policy revealed that it does not provide legal framework for emergence services to farmers in case of risk of losing production because of natural disasters like flood, drought, quarantine and the like. The policy did not have any instruments that encourage formation of joint farming societies like Block Farming System that can enhance efficiency and improve productivity of the farming enterprises and ultimately ensure profitability among the smallholder farmers. The policy also does not provide legal framework that will ensure a sustainable monetary support by Government to the improvement of smallholder farmers' productivity.

The National Microfinance Policy requires that the Government should allow microfinance institutions to set interest rates freely (URT, 2000).The implication of this policy is that it gives flexibility to the microfinance institutions to charge high interest rates which impairs the ability of the loan recipients to pay the loans timely. Higher interest rates also increase the operating cost of farming undertakings and have a negative effect on profitability of the smallholder farmers. Unfortunately the policy does not make any legal framework that requires the microfinance institutions to pay adequate interest rate to its savers.

The Agricultural Sector Development Strategy (ASDS) was formulated partly as a mechanism to re-invigorate the agricultural sector and consequently, the national economy. The primary objective of the ASDS is to create an enabling and conducive environment for improving profitability of the agriculture sector as the basis for improving farm incomes and reduce poverty in the medium and long-term. The medium term objectives of the ASDS are determined by the National Strategy for Growth and Reduction of Poverty (NSGRP) and the long term goals by the Tanzania Development Vision 2025 (URT, 2007)

According to Khijjah (2004), sustainable rural financial market development requires the existence of the demand for credit, efficiently managed credit operations and minimal transaction costs, as well as interest rates that are low enough to be acceptable to borrowers yet sufficient to cover administrative costs. On the other hand, creditors need high loan recovery rates for capital preservation and overall profitability, as well as successful savings mobilization in order to increase the capital lending base.

The Tanzania Development Vision 2025 outlines the goals of sustainable livelihoods and sustained economic growth. Accordingly, the Government's vision for the development of rural financial markets in the country is rooted in four policy-strategies, namely, National Microfinance Policy, Rural Development Strategy, Agriculture Sector Development Strategy, and a Cooperative Development Policy. The Government has also put in place a credit guarantee facility to encourage agricultural lending, (Khijjah, 2004).

The Sugar Industry Act 2001 provides legislative framework that defines the roles and relationship among the various stakeholders in the sugar industry. Stakeholders are groups or organisations that has direct or indirect stake in the sugar industry in Tanzania. Sugar Board of Tanzania (SBT) has been given power to register all sugarcane outgrowers in the country, directly or through agents. Only registered sugarcane farmers are allowed to grow sugarcane for the purpose of selling to the sugar processing factories (SBT, 2010).

2.7 Literature Review Summary

Improvement in productivity through investment in agricultural sector is necessary for accelerated economic growth. Continued profit from agriculture activities have been mentioned as one of the essence of its sustainability. The literatures had also mentioned production quotas for farmers, labour cost, fertilizers cost and costs of seed cane as some of factors that are affecting profitability of sugarcane production. It was also mentioned that in order to profit from contract sugarcane farming, farmers need to double their current mean yield per hectare. Access of loan is helpful to poor farmers. However, it has been mentioned that smallholder schemes are constrained by poor loan repayment. Regression models such as least square methods, Logit and Probit models as well as t-Test and ANOVA were used in various studies of sugarcane profitability and loan repayment respectively.

Review of the Agricultural and Livestock policy (URT, 1997) and the National microfinance Policy (URT, 2000), has shown that the policies does not provide adequate legal frameworks for the formulation of joint farming societies, financial support to smallholder farmers in case of emergencies and legal frame that will require the Microfinance Institutions to charge moderate interest rates while at the same time offers adequate interest rates to their savers.

2.8 Research Gap Identified

Despite the fact that BFS which is a new strategy in Tanzania, had enabled a significant performance on the smallholders' sugarcane production with 44 percent more sugarcane yield per hectare as compared to TFS, comparative analysis between BFS and TFS on the profitability of the two smallholder sugarcane farming system in Tanzania has not been documented and need to be conducted. Comparative assessment of effects of the two farming systems on loan repayment rate has also not been documented and need to be done.

2.9 Theoretical and Conceptual Frameworks

From the viewpoint of Actor Network Theory (ANT) and Luhmann's theory of social system which understands a farm enterprise as a self-organizing system, (Noe & Alroe, 2012), the study of the profitability of the smallholder farming systems in Tanzania draws from the system coordination theory, (Rehber, 2006) and also from neoclassical theory of the firm. The neoclassical microeconomic theory provides that the main objective of a business entity is profit maximization. The norm of profitability is a firm's revenue. The firm is subjected to various costs, variable and fixed, before it sees any revenue.

The generated revenue depends upon price and quantity of the good sold. Although market price is dependent on market forces, quality of produces is also an important determinant of price. In the case of commercial agriculture like sugarcane farming, production yield makes up the quantity of good sold. The achieved yield per unit area is dependent on various factors and as well as on how these factors are coordinated to ensure the entity attains its goal of profit maximization.

In the case of smallholder sugarcane farming in Tanzania, two farming systems are in practice. The two systems are the Block Farming system (BFS) which is based on the network coordination theory and the Traditional Farming system (TFS) which is based on the hierarchies' coordination theory (Rehber, 2006). Through BFS smallholder sugarcane farmers in neighbourhood join their small pieces of land to form one homogeneous block with size ranging between 20 and 30 hectares with an aim to take advantage of economies of scale via collective management of various inputs as well as by overcoming the obstacles of fixed cost per unit of necessary infrastructural investment. In Traditional Farming Systems the smallholder farmers are farming in small pieces of land, normally less than 0.4 to 2.02 hectares.

Size of farms is crucial when it comes to benefits of economies of scale. The revelation by Malonga et al (2009) of the fact that miller cum planters and commercial sugarcane farmers use blocks of about 20 to 30 hectares all over the world testify how uneconomical is to grow this crop in small and fragmented plots and thus justify the introduction of block farming system. The profitability of a commercial entity like sugarcane farming depends also on effective coordination of various factors key into generating and enhancing sustainable profit from the farming operations.

In this study the profitability of the BFS and TFS is comparatively assessed through the interaction or coordination of the two farming systems on five factors, namely, land size, yield (production output per hectare), price, sucrose content (a quality measure) and cost. The independent variables BFS and TFS under the influences of network coordination theory and hierarchies' coordination theory, (Rehber, 2006), respectively, are assessed to determine their effects into ensuring a profitable smallholder farming. Two independent tests, one for BFS and another for TFS are conducted to assess profitability of the two farming systems and their effect on loan repayment performance.

The conceptual framework in Figure 2.1 conceptualize that Profitability of the smallholder farmers depends on two farming systems, namely Block Farming System and Traditional Farming System. Land size, sugarcane yield per hectare, sucrose content in sugarcane, price of sugarcane per tonne and total costs per hectare are the main factors hypothesized to have effects on the profitability of the smallholder farming systems. Profitability is also hypothesized to have effect on loan repayment rate. In this context correlation between profitability and loan repayment rate will also be investigated.

2.9.1 Description of Model Variables

2.9.1.1 Profitability

Profitability is the dependent variable in this study. Profitability is the ratio of operating income to the revenue. It is the ratio or percentage of profit attained by smallholder sugarcane farmers and was calculated basing in one hectare of the sugarcane farm owned by the farmer.

2.9.1.1.1 Mediating Variables for Profitability

Land size, sucrose, yield, price and cost are the mediating variables hypothesized to have effect on the profitability of smallholder sugarcane farmers. Land size is measured in hectare and it indicates the size of the farm owned and planted with sugarcane by the smallholder sugarcane farmer. Sucrose is the amount of sugar in sugarcane indicated in percentage. Sucrose content is a quality measure and is determined by the miller through laboratory analysis when sugarcane is delivered to the factory.

Yield, measured in tons per hectare, is the amount of sugarcane realized by the smallholder sugarcane farmer from his/her farm. Price, measured in Tanzania shillings (TZS), is the price of sugarcane per ton paid to a farmer. Price is set during cane supply agreement between the miller and sugarcane growers associations. Cost, measured in TZS is the total operating cost per hectare incurred by the sugarcane farmer. This includes pre-harvest and post-harvest costs.

2.9.1.2 Loan Repayment rate

Loan repayment rate has been calculated by dividing the loan repaid timely by the total loan amount. Effective loan repayment depends on a number of factors including interest rate/amount, loan transaction cost (Ngaruko, 2010), loan size, repayment period, loan utilization, profit achieved from the business undertaken, etc. However, the focus of this study is to assess the effect of the profitability of the smallholder sugarcane farming systems on loan repayment rate.

2.9.1.3 Block Farming

Block Farming is one of the two independent variables of this study. It is a farming system whereby smallholder sugarcane farmers with small farms in one locality and sharing borders, join their farms to form one homogenous block farm. The expectation is to take advantage of economies of scale to enhance their production and optimize returns (Basimwaki et al. 2007). The farmers manage the block farm collectively basing on their agreement. The income realized after selling the sugarcane and deduct all costs is divided proportionately basing on the size of farm contributed by each member of the block farm.

2.9.1.4 Traditional Farming

Traditional Farming is the second independent variable of the study. This is the farming system adopted, not only by the majority of smallholder sugarcane farmers, but also by farmers of other cash and food crops in Tanzania and perhaps elsewhere in Africa. In this farming system, smallholder sugarcane farmers who own small pieces of land (< 0.40 to 2.02 ha) manage their farms individually and have all the decisions about their farms, produce and income realized thereof (Mushi, 2012).

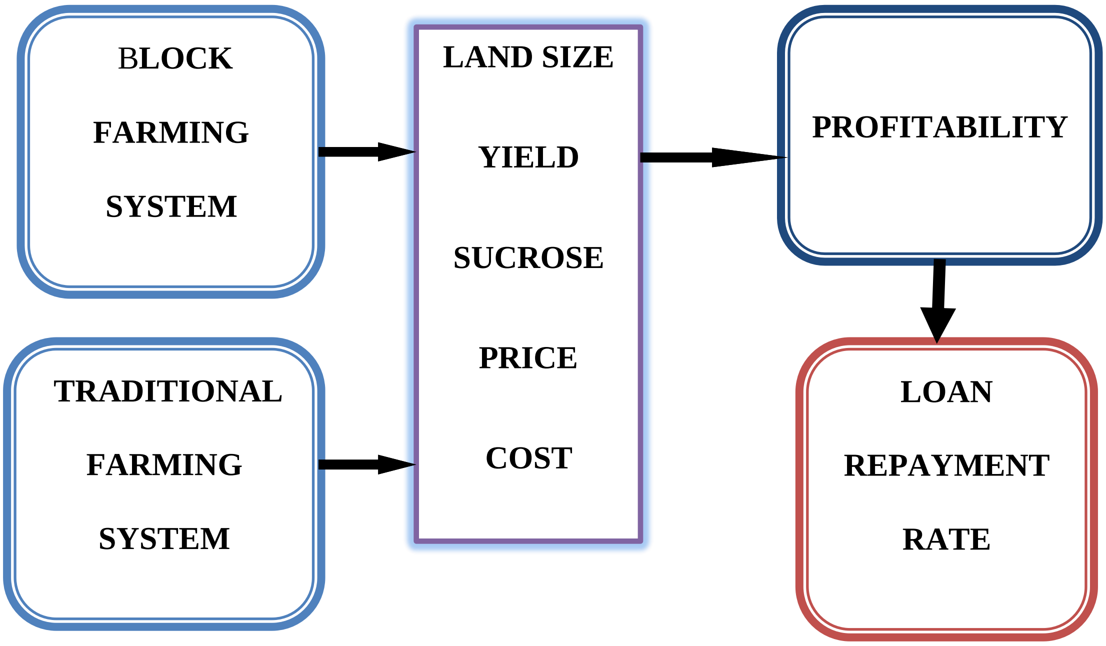


Figure 2.1: Conceptual Framework

It is expected that the outcome of this study on the profitability of smallholder farming systems in Tanzania will establish facts on the effectiveness of the newly introduced smallholder Block Farming System in comparison to the long established Traditional Farming System on profitability realized by smallholder farmers practicing either of the two farming systems. The study will also establish facts on the effects of the profitability attained through BFS and TFS on loan repayment performance. The new facts to be established will enable farmers and other stakeholders including policy makers to make informed decision on an appropriate smallholder farming system relevant to Tanzania.

On the theoretical perspective, the study will try to establish and provide an argument on efficacy of farming systems based on the network coordination theory (cooperative and corporate coordination) in comparison to those based on hierarchies' coordination theory (full ownership integration) on profit maximization.

On the policy standpoint, basing on the outcome of the study it is expected to recommend various reviews and amendments on the National Agriculture and Livestock policy and the National Microfinance policy with aims to ensure a sustainable and profitable smallholder farming. Finally, basing on the current conceptual framework, it is also expected to develop a model for future studies of profitability and loan repayment of smallholder farming systems.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Overview

This chapter provides an outline of the research philosophy, research design and methodology for this thesis. The main focus is to present a systematic flow of the entire design of the research process. This ex-post facto research is driven by the desire to examine quantitatively the profitability of smallholder sugarcane farming systems in Tanzania through comparative analysis between Block Farming system (BFS) and Traditional Farming systems (TFS) in Morogoro. Analysis of the impact of the independent variables BFS and TFS on the dependent variable Profitability has been conducted. The study intends to also examine correlation between loan repayment rate and profitability. The study aims to test three hypotheses.

3.2 Research Philosophy

The philosophy used in this study is positivism. While methodology is an approach to knowing, positivism fits to epistemology which can be specified as philosophy of knowing. Positivism is a philosophy that adheres to the view that only factual knowledge gained through observation, including measurement is reliable. The role of researcher in positivism is limited to data collection and interpretation through objective approach and the research findings are usually observable and quantifiable. Moreover, in positivism studies the researcher is independent from the study and there are no provisions for human interests within the study, (Collins, 2011).

3.3 Research Design

It was reported by Crowther & Lancaster, (2008) that as a general rule, positivist studies usually adopts deductive approach. With this paradigm, this study has used the cross-sectional survey strategy associated with deductive approach to analyse comparatively the profitability of smallholder sugarcane farming systems in Tanzania. The descriptive analytical research has examined and explained cause-and-effect relationships between variables.

According to Saunders et al (2012), questionnaires are normally used for descriptive and explorative studies; therefore, primary data required for this study have been collected by using self-completed questionnaires administered to a random sample. Appropriate secondary data was requested from Kilombero Sugar Company, sugarcane farmers associations and from financial intermediaries. Quantitative analysis techniques such as graphs, charts, and statistics mentioned by Saunders et al (2012) to be helpful into explore, present, describe and examine relationships within collected data have also been applied.

The strategy chosen enabled an empirical assessment of the profitability of the smallholder sugarcane farming systems in Tanzania whereby comparative analysis between Block Farming and Traditional Farming systems was done. The profitability was assessed by first describing the determinants of profitability of the two smallholder sugarcane farming systems. Then examination of the effects of these determinants on the profitability has been performed. The correlation between loan repayment rate and the profitability of the farming systems has been examined.

3.3.1 Geographical Description of the Study Area

Morogoro is located on the south-eastern Tanzania Mainland and lies between latitudes $5^o58'$ and $10^o00'$ South of the Equator, and between longitudes $35^o25'$ and $38^o30'$ East of Greenwich. Morogoro has a total area of 73,039 km² out of which 2,240 km² is covered by water, making it ideal for sugarcane farming. The Region covers about 7.7 Percent of the total area of Tanzania, URT (2007).

3.3.2 Research Justification of the Study Area

Morogoro region was selected as an appropriate study area because of the existence of thousands of contract smallholder sugarcane farmers practicing Block Farming and Traditional Farming system respectively. These smallholder farmers are selling their sugarcane to two sugar processing companies located in the region namely Kilombero Sugar Company who own a distillery and two sugar processing factories one in Kilosa and another in Kilombero districts, and Mtibwa Sugar Estate located in the Mvomero district. However, since there are twelve well developed block farms in the Kilombero area as compared to only two underdeveloped block farms in Mtibwa, the study focused on the smallholder farmers in the Kilombero valley.

3.4 Sampling Method

Multistage random sampling, explained by Saunders et al (2012), to be normally used to overcome problems associated with geographically dispersed population have been used in this study. At the first stage, purposive sampling was used to select an appropriate study region in the mainland Tanzania, where there are four major sugarcane producing areas located in Morogoro region (two areas), Kilimanjaro region and Kagera region. Among these three regions, Morogoro region has a big number of smallholder sugarcane farmers practising both TFS and BFS. There is no commercial contract smallholder sugarcane farmers in Kilimanjaro and less than 600 are in Kagera region. Therefore Morogoro region is a favourable study area.

The second stage of the sampling design involved a selection of an appropriate study area within the Morogoro region. In this region there exists Mtibwa Sugar Estate (MSE) in Turiani valley and Kilombero Sugar Company (KSC) located in Kilombero valley. Due to a good number of well-developed block farms in Kilombero, the area has been selected purposively (Saunders et al. 2012) as an appropriate study area to assess the profitability of smallholder sugarcane farming systems in Tanzania.

The third stage involved a random selection of respondents in Kilombero where there are two major areas namely, Kilombero 1(K1) located in Kilombero district and Kilombero 2 (K2) located in Kilosa district. The respondents are smallholder contract sugarcane farmers practicing Traditional Farming and Block Farming System, respectively, in the area. To ensure a good mix of the sugarcane farmers, all twelve well developed block farms in K1 and K2 have been involved in the study. Also, at the third stage, purposive sampling of banks and other microfinance institutions extending loans to the smallholder farmers was made.

3.5 Samples and Sampling Technique

3.5.1 Sampling Technique

The required sample indicated in Table 3.1 was randomly drawn systematically from the smallholders' sugarcane farmers register found at the Kilombero Sugar Company Outgrowers Services department. The register was first organized in two sampling frame basing on the two sugarcane farming areas in Kilombero namely Kilombero 1 (K1) and Kilombero 2 (K2) and from each of the two locations, the farmers were arranged basing on their farming associations. From each association and starting with the fifth listed smallholder farmer every eighth farmer was picked. Then the questionnaires were distributed to the selected participants through the assistance of data collectors. All twelve active block farms were purposively involved in the study and the questionnaires were distributed to their officials. Purposive sampling was used to select financial intermediaries involved in the study.

Table 3.1: Randomly drawn participants from Sampling Frames

Sampling frame	registered farmers	drawn participants
Kilombero 1	5055	256
Kilombero 2	3420	174
Total	8475	430

3.5.2 Sample Size

One method of getting a sample size is by using sample size formula, (Kothari, 2004). However, approximations of participants by using computer programs to conduct power analysis are considered to be the best approach. For the purpose of this study of the profitability of smallholder sugarcane farming systems in Tanzania, G*Power statistical software, (Faul et al 2009) was applied to calculate the required sample size. Figure 3.1 shows the distribution plot of the priori analysis for the required sample size, whereas Figure 3.2 shows the X-Y plots for range of values which displays total sample size required for various alpha levels. A priori analysis with an alpha level of 0.05 and a power factor of 0.85 has been used in the current study which gives a required total sample size of 430 participants.

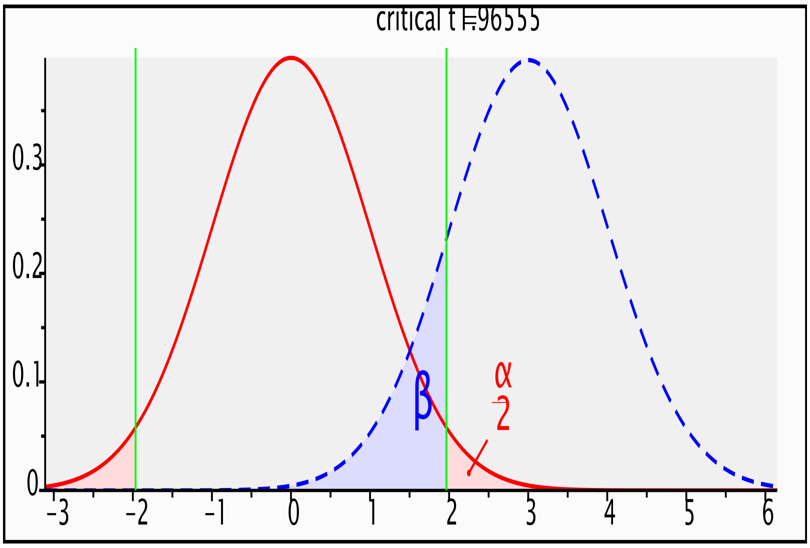


Figure 3.1: Distribution plot for priori analysis of required sample size

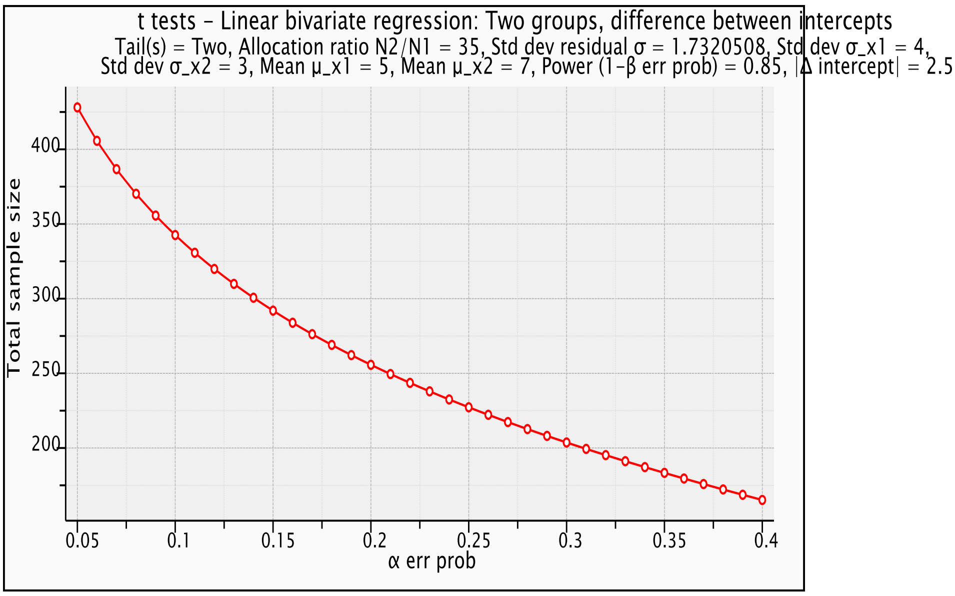


Figure 3.2: Sample size distribution plot for participants from BFS and TFS

Source: Generated from G*Power package for the current study

An allocation ratio of 35 have been used to calculate the sample size required for the Block Farming System (BFS) and Traditional Farming System (TFS) basing on the population of smallholder sugarcane farmers practising block farming and traditional farming. Total population of smallholder sugarcane farmers is estimated to be above 8000. Currently there are 12 block farms in active operations. Table 3.2 indicates the distribution of the required sample size between BFS and TFS.

Table 3.2: Sample size distribution between BFS and TFS

Farming System	Required Sample Size
Traditional Farming	418
Block Farming	12
Total	430

Source: Generated from G*Power package for the current study

3.6 Study Population

The required sample size of 430 participants have been drawn from a population of more than 8,000 contract smallholder sugarcane farmers located in the Kilombero valley within Kilombero and Kilosa districts, (SBT, 2010). These farmers are practicing Block Farming and Traditional Farming systems. From these study population, primary and secondary data were collected. Other secondary data were collected from the Kilombero Sugar Company databases and selected Outgrowers Associations.

3.6.1 Key Demographics

Figure 3.3 indicates that response from 394 participants (92% of the required sample size) have been used in the study. 237 (60.15%) participants reside in Kilombero

1(K1) located in the Kilombero district of the Morogoro region and 157 (39.8%) participants are located in Kilombero 2 (K2) within the Kilosa district.

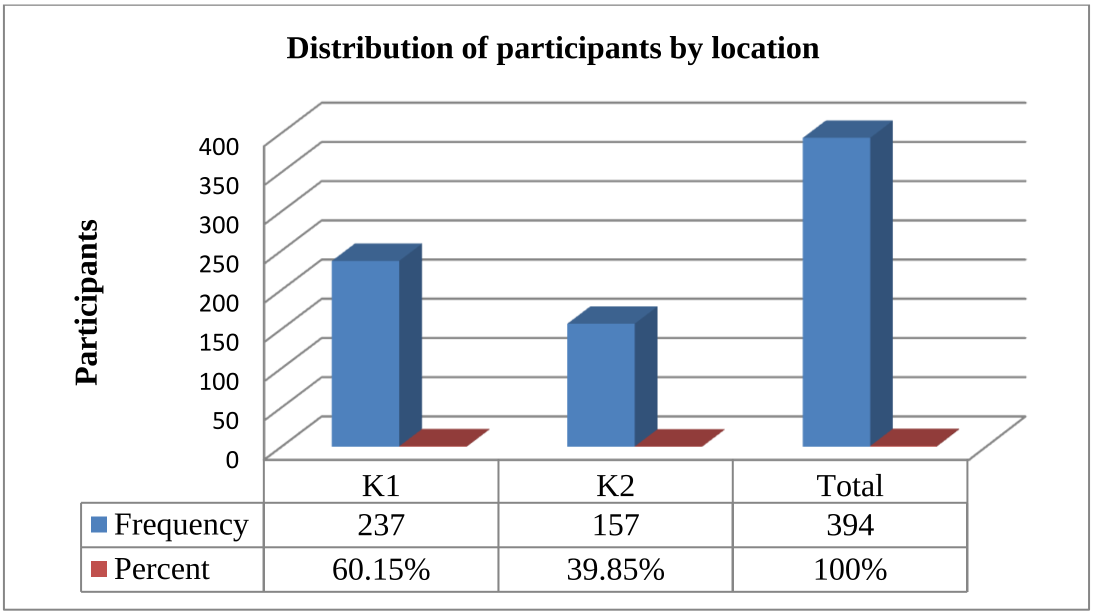


Figure 3.3: Distribution of respondents by location

Figure 3.4 reveal that 145 (36.8%) of the participants were female and 237 (60.15%) were males. 12 (3.05%) labelled “mixed” are responses from block farms officials.

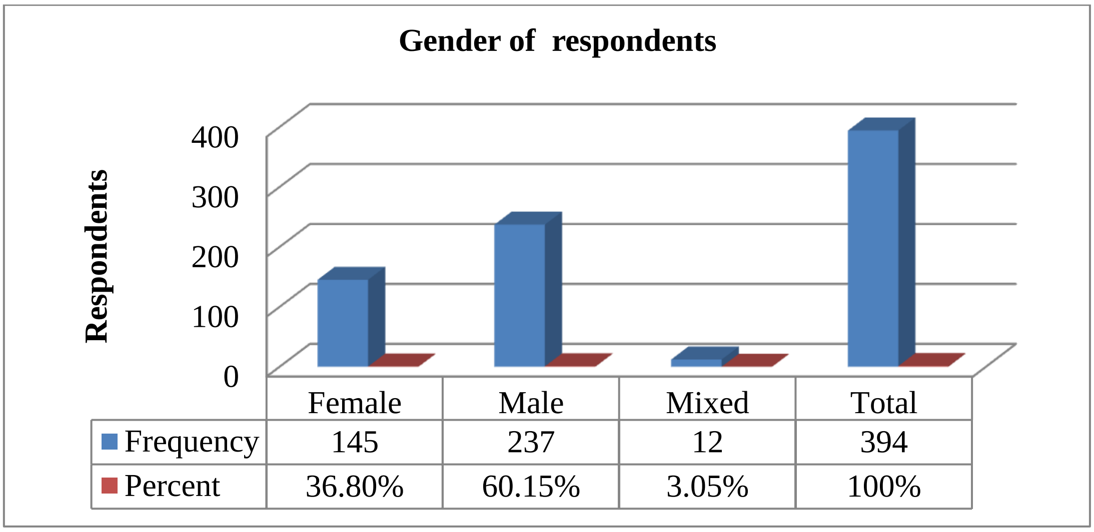
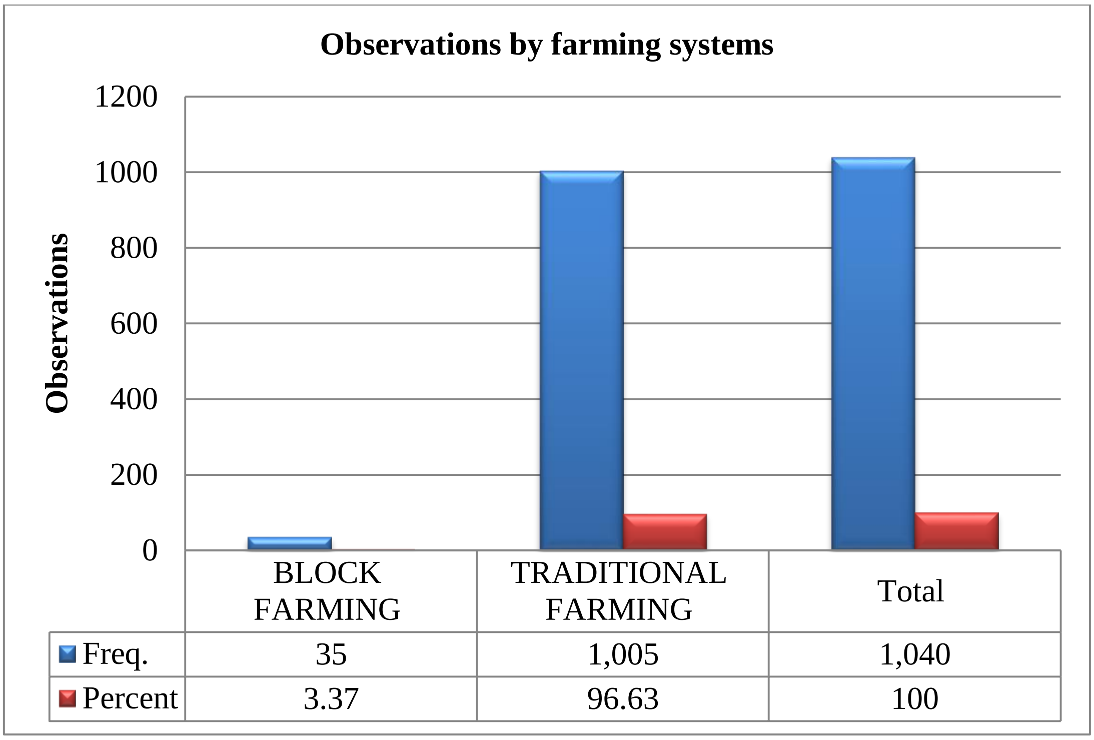


Figure 3.4: Gender of respondents

Each participant was expected to provide data for five years from 2008 to 2012. This means for each element asked a farmer was expected to provide between one and five observations. Figure 3.5 reveals that 1040 observations from the 394 participants were used in the study of the profitability of smallholder sugar farming systems. Out of these, 1005 (96.63%) observation are from 382 traditional farmers who had returned the questionnaires and 35 (3.37%) observation are from official of block farms.



	BLOCK FARMING	TRADITIONAL FARMING	Total
Freq.	35	1,005	1,040
Percent	3.37	96.63	100

Figure 3.5: Observation by farming systems

Figure 3.6 indicates respondents' age distribution. The age group 18-35 represents 47 percent of respondents. About 33 percent of respondents are from the age group 36-49. The age group 50-60 has been represented by about 14 percent of the respondents. About 3 percent of respondents were above 60 years and about 3 percent referred to as various are officials of block farms.

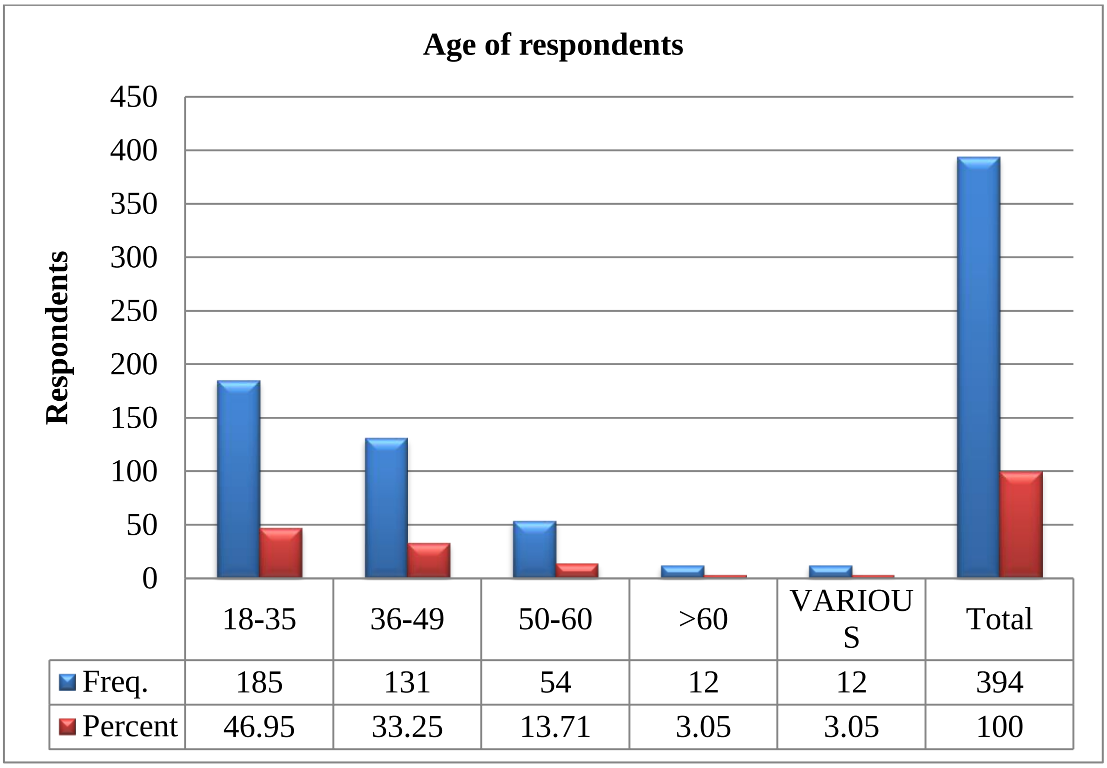


Figure 3.6: Distribution of respondents' ages

3.7 Data Collection Methods

Primary data were collected through a semi structured questionnaires (see appendix 1) distributed to randomly selected smallholder farmers, officials of selected banks and microcredit associations. Secondary data were gathered through a documentary review of data from the Kilombero Sugar Company, farmers associations, selected banks and microcredit associations in the area randomly selected in the third stage.

3.7.1 Instrument Validity and reliability

Validity and reliability are important aspects of questionnaire design. While validity measures degree to which the measurement procedure actually measures the concept that is intended to measure, reliability refers to consistency and/or repeatability of the measurement. Test-retest reliability strategy was used to pre-test the instrument on

20 respondents in an interval of two weeks. Test results in Table 3.3 shows that The Cronbach' alpha coefficient from the test was 0.7862 which suggests that the responses on items tested have relatively high internal consistency.

Table 3.3: instrument reliability test

.alpha land size1 land size2 yield1 yield2 sucrose1 sucrose2 price1 price2 revenue1 revenue2 cost1 cost2	
Test scale = mean(unstandardized items)	
Average inter item covariance	1.41e+12
Number of scale in the scale	12
Scale reliability coefficient	0.7862

Content validity test was done after organising the collected pilot test data and the results in Table 3.4, *t*(19} = -2.49, *p* = 0.02 suggests that there is a significant internal content validity of the collected data.

Table 3.4: Instrument validity test

t-Test profitability ==0.5 in 1/20

Variable	Mean	Std. Dev.	df	t	p value
Profitability	0.4025	0.1753	19	-2.487	0.0224

3.9 Analytical Methods

To facilitate appropriate decision on analytical methods to be used in this study, both parametric tests and non-parametric tests (Higgins, 2004) have been explored and non-normality tests have been conducted to the data sets to allow for informed decisions to be made. The following subsections discuss various methods and various tests performed on the data sets.

3.8 Parametric versus Non-Parametric Tests

Parametric tests like, t-Test, ANOVA and Pearson correlation test are applied to test data sets when the population is normally distributed (Saunders et al. 2012). It is more beneficial to use Z, t or F test when performing an inference about means, and the results are generally more accurate. However, if the data sets in the population are not normally distributed, the data sets need to be transformed appropriately so as to achieve the Gaussians distribution. Parametric analysis of transformed data is considered a better strategy than non-parametric analysis because the former appear to be more powerful than the latter (Rasmussen & Dunlap, 1991).

3.8.1 Non - Normality Test for the Profitability Data

Non-normality test have been conducted to assess if the data is normally distributed and consequently apply appropriate transformations tests like the Tukey ladder test (Mallows & Tukey, 1982). Shapiro-Wilk test of the null hypothesis of normality at alpha level 0.05 was applied to check for non-normality of the predictor variables data sets for the smallholder sugarcane farming systems profitability. The Shapiro-Wilk test results in Table 3.5 suggest a rejection of the null hypothesis of normality for all the predictor variables hypothesized in this study. Ladder tests have been used to check for an appropriate transformation for each of the variable.

Table 3.5: Shapiro-Wilk test for non-normality of profitability data

Variable	Obs	W	V	z	Prob > z
Land size	1040	0.46670	348.584	14.520	0.0000
Yieldha	1040	0.98402	10.447	50820	0.0000
Price	1040	0.97896	13.749	6.501	0.0000
Sucrose	1040	0.98966	6.758	4.739	0.0000
Costha	1040	0.93320	43.662	9.367	0.0000
Profitability	1040	0.98556	9.436	5.567	0.0000

3.8.2 Profitability Data Set Transformation

Table 3.6 indicates that the data set for profitability requires no transformation.

Table 3.6: Ladder test for transformation of profitability data set

Transformation	Formula	Chi2(2)	P(chi2)
Cubic	profitability^3	.	0.000
Square	profitability^2	73.47	0.000
Identity	profitability	42.003	0.000
Square root	Sqrt(profitability)	.	.
Log	Log(profitability)	.	.
1/(square root)	1/sqrt(profitability)	.	.
Inverse	1/(profitability)	.	.
1/square	1/(profitability^2)	.	.
1/cubic	1/(profitability^3)	.	.

3.8.3 Land Size Data Set Transformation

Table 3.7 reveals that the reciprocal of the square root has the minimum Chi square value therefore the data set should be transformed to the reciprocal of its square root.

Table 3.7: Ladder test for transformation of land size data

Transformation	Formula	Chi2(2)	P(chi2)
Cubic	land sizeha^3	.	0.000
Square	land size ^2	.	0.000
Identity	land size	.	0.000
Square root	Sqrt(land size)	.	0.000
Log	Log(land size)	.	0.000
1/(square root)	1/sqrt(land size)	52.49	0.000
Inverse	1/(land size)	.	0.000
1/square	1/(land size ^2)	.	0.000
1/cubic	1/(land size ^3)	.	0.000

3.8.4 Yield Data Set Transformation

Table 3.8 reveals that the square root has the minimum Chi square value for the variable yield thus yield data set should be transformed to its square root.

Table 3.8: Ladder test for transformation of yield data

Transformation	Formula	Chi2(2)	P(chi2)
Cubic	yieldha ^3	.	0.000
Square	yieldha ^2	.	0.000
Identity	yieldha	46.08	0.000
Square root	Sqrt(yieldha)	3.92	0.041
Log	Log(yieldha)	30.21	0.000
1/(square root)	1/sqrt(yieldha)	.	0.000
Inverse	1/(yieldha)	.	0.000
1/square	1/(yieldha ^2)	.	0.000
1/cubic	1/(yieldha ^3)	.	.

3.8.5 Sucrose Data Set Transformation

Table 3.9 reveals that the square transform for the variable sucrose has the minimum Chi square value therefore the data set for the variable should be transformed to its square.

Table 3.9: Ladder test for transformation of sucrose data

Transformation	Formula	Chi2(2)	P(chi2)
Cubic	sucrose ^3	27.89	0.000
Square	sucrose ^2	4.51	0.045
Identity	sucrose	5.04	0.081
Square root	Sqrt(sucrose)	16.81	0.000
Log	Log(sucrose)	36.73	0.000
1/(square root)	1/sqrt(sucrose)	65.32	0.000
Inverse	1/(sucrose)	.	0.000
1/square	1/(sucrose ^2)	.	0.000
1/cubic	1/(sucrose ^3)	.	.

3.8.6 Price Data Set Transformation

The results in Table 3.10 reveals that logarithm transform has the lowest Chi square value and therefore ideal for the variable price.

Table 3.10: Ladder test for transformation of the predictor variable price

Transformation	Formula	Chi2(2)	P(chi2)
Cubic	price ^3	70.70	0.000
Square	price ^2	61.47	0.000
Identity	price	.	0.000
Square root	Sqrt(price)	56.79	0.000
Log	Log(price)	41.08	0.000
1/(square root)	1/sqrt(price)	.	0.000
Inverse	1/(price)	.	0.000
1/square	1/(price ^2)	.	0.000
1/cubic	1/(price ^3)	.	.

3.8.7 Cost Data Set Transformation

Table 3.11 shows that logarithm transform for the variable costha has the minimum Chi square value therefore the data set should be transformed to its logarithm.

Table 3.11: Ladder test for transformation of the variable costha

Transformation	Formula	Chi2(2)	P(chi2)
Cubic	costha ^3	.	0.000
Square	costha ^2	.	0.000
Identity	costha	.	0.000
Square root	Sqrt(costha)	29.37	0.000
Log	Log(costha)	10.44	0.005
1/(square root)	1/sqrt(costha)	.	0.000
Inverse	1/(costha)	.	0.000
1/square	1/(costha ^2)	.	0.000
1/cubic	1/(costha ^3)	.	.

3.8.8 Non-Normality Test for Loan Repayment Data Set

The result of the Shapiro – Wilk test (see Table 3.12) conducted on the loan repayment data collected for the purpose of examining the correlation between loan repayment rate and the profitability of the smallholder farming revealed a non-normal distribution. This non-normality of the distribution call for a non-parametric test and therefore the Spearman's rank correlation test has been used.

Table 3.12: Shapiro-Wilk test for loan repayment data

Variable	Obs	W	V	z	Prob > z
Land size	79	0.80108	13.513	5.701	0.0000

3.9 Analysis of Quantitative Data

Following the outcome of the non-normality test and transformation of data sets for the study of profitability of smallholder sugarcane farming systems in Tanzania, the quantitative data was analysed using descriptive statistics such as mean, standard deviation and percentage to investigate the relative importance of major variables hypothesized to influence the profitability of sugarcane farming systems and its correlation to loan repayment rate.

One way ANOVA, and an independent t-Test, at significance level of $p = 0.05$ have been applied to test the variability of the means of the factors of profitability of the two smallholder sugarcane farming systems. Spearman's rank correlation test have been used to assess the association between profitability and land size, sugarcane yield, sucrose content, price of sugarcane per tonne and total cost per hectare . The causal effect of the hypothesized factors on profitability have been analysed by the use of Tobit regression analysis. The correlation between profitability and loan repayment rate have been analysed by the Spearman's rank correlation test.

3.9.1 Regression Analysis of the Determinants of Profitability of the Farming Systems.

Two - limit Tobit regression model as explained in detail by Amemiya (1985) and shown in Equations 9 and 10 in Chapter two was applied to examine causal effect of the hypothesized factors of the profitability of the smallholder sugarcane farming systems in Tanzania. The Tobit model was censored between 0 and 0.8 basing on arbitrary assumption that smallholder farmers will spend at least 20% of their revenue to finance both pre- harvest and post-harvest operations per hectare. The lower limit was chosen basing on an arbitrary assumption that the revenue expected equals the total cost spent. The general Tobit model for the regression analysis of the profitability factors is presented in Equation 23:

$$PROFIT = \beta_0 + \beta_1 LAND + \beta_2 YIELD + \beta_3 SUCROSE + \beta_4 PRICE + \beta_5 COST + \varepsilon \quad \ldots\ldots (23)$$

PROFIT represents profitability which is a ratio found by dividing the operating income to the total revenue achieved by each respondent. LAND represents the size of land in hectares used for sugarcane farming in a particular year as indicated by each respondent. YIELD is measured in tonnes per hectare and was calculated by dividing the total tonnes supplied by an individual farmer to the total area harvested in a particular year.

SUCROSE measured in percentage is the content of sucrose amount measured from a volume of sugarcane juice. Sucrose content is measured in sugar factories laboratories and is a key determinant of sugarcane price. The model variable PRICE stands for the price of sugarcane per tonne in Tanzania shillings. COST stands for the total cost incurred by the smallholder sugarcane farmers per hectare. Total cost per hectare was calculated by dividing the total cost incurred by each respondent to the size of the farm planted with sugarcane. The cost includes pre-harvest and post-harvest costs. β_i are the coefficients of the model.

3.9.2 Interpretation of the Tobit Coefficients as the Effects of the IV on DV

Contrasting ordinary least square regression, Tobit coefficients cannot be interpreted as the effect of the independent variables (IV) on the dependent variable (DV), (Amemiya, 1979). Mc Donald & Moffitt (1980), presented two formulas for predicting the observed dependent variable y, as indicated in Equations 24 and 25 without subscripts:

If $X\beta + e > 0$, then $y = X\beta + e$……………………..……………….……..………......….(24)

If $X\beta + e \leq 0$, then $y = 0$…………………………..………....……………...………..(25)

Where Xβ is a vector of the values on X (the independent variables multiplied by the approximate Tobit coefficient β) and e is the normally-distributed error term.

Mc Donald & Moffitt (1980) also presented a formula for finding the expected value of the dependent variable for all cases as shown in Equation 26.

$$Ey = X\beta \times F(z) + \text{sigma} \times f(z) \qquad (26)$$

Where X and β are defined as in Equation 25, Ey is the expected value of the dependent variable, F(z) is the cumulative normal distribution function associated with the proportion of cases above the limit, f(z) is the unit normal density (value of the derivative of the normal curve at a specific point), z is the z-score for an area under the normal curve, and sigma is the standard deviation of the error term reported by the applicable Tobit model.

First-order partial derivative of Equation 27 as presented by Mc Donald & Moffitt (1980) is used to find the effect of an independent variable on the expected value of the dependent variable Ey, for all cases in a Tobit analysis. The formula for this derivative, $\delta Ey/\delta X_i$ is:

$$\frac{\delta Ey}{\delta Xi} = F(z) \times \frac{\delta Ey*}{\delta Xi} + Ey * \times \frac{\delta F(z)}{\delta Xi} \qquad (27)$$

Where F(z) is as defined in Equation 26, Ey^* is the expected value of y for the cases above the limit. δEy*/δXi, is the change in the expected value of y for cases above the limit. δF(z)/δXi, the change in the cumulative probability of being above the limit associated with an independent variable.

The two terms in Equation 27 identify the two effects in the Tobit model. Mc Donald & Moffitt (1980) presented formula for calculating these two terms and Madalla, (1992) gave their derivations. For cases above the limit Equation 28 is applicable:

$$\frac{\delta Ey}{\delta Xi} = \beta i \times \left[1 - \left(z \times \frac{f(z)}{F(z)}\right) - \frac{f(z)^2}{F(Z)^2}\right] \qquad (28)$$

For the case at the limit, Equation 29 is used:

$$\frac{\delta F(z)}{\delta Xi} = \beta i \times \frac{F(z)}{sigma} \qquad (29)$$

Where β_i is the Tobit coefficient for a partial independent variable, z is z score associated with the area under the normal curve, and the terms are as defined earlier.

Mc Donald & Moffitt (1980) provided a simple strategy for finding F(z) that provides the key to obtaining z and f(z). They showed that the first-order partial derivative across all cases in Equation 27, $\delta Ey/\delta Xi$, equals F(z) x β_i. They described the first-order partial derivative with respect to a particular independent variable across all cases. Madalla (1992) defined the first-order partial derivative as the effect of an independent variable on the observed dependent variable without information whether any observed value is greater than zero. Because F(z), which corresponds to the proportion of cases above the limit, is always less than 1.0, the influence of any independent variable across all cases is always some proportion of the Tobit coefficient. If $F(z) \geq 0.5$, the preferred area is obtained by subtracting 0.5 from the F(z) value. If $F(z) \leq 0.5$, the looked-for area is $0.5 – F(z)$.

3.10 Ethical Issues

All ethical issues have been strictly observed and it is hereby declared that secrecy and confidentiality will be maintained and that data and information obtained from any organization in the course of this research have and will only be used for the purpose of academic endeavours.

CHAPTER FOUR

FINDINGS AND DISCUSSIONS OF THE STUDY

4.1 Overview

This chapter presents results and discussion on the analysis of the data for the study of the profitability of the smallholder sugar farming systems in Tanzania. Profitability is achieved when a business is able to deliver products and services to the market at a price that covers expenses and generates a profit (Bowman, 2011). The chapter will have two major sections. In the first section, findings and discussions of various analysis of the profitability of farming systems are presented. The second section covers the findings and discussions on the effect of profitability of the farming systems on loan repayment rate. Results obtained in both sections will be crucial into the test of the hypotheses of this study which seeks to find if:

i. There is any significant difference on the factors affecting the profitability of the smallholder sugarcane farmers between Block Farming System and Traditional Farming Systems; if
ii. Block Farming System is not more effective than Traditional Farming System in ensuring the profitability of the smallholder sugarcane farmers; and if
iii. There is no correlation between the profitability of smallholder farming systems and the loan repayment rate of the smallholder sugarcane farmers.

4.2 Profitability of Smallholder Sugarcane Farming Systems

In this section, results on the analysis conducted to study the profitability of the smallholder sugarcane farmers practicing Block Farming and Traditional Farming systems, respectively, are presented. The results obtained in this section will be crucial into the testing of the second hypothesis of this study which pursues to find if there is any significant difference on the effectiveness of the two farming systems into ensuring the profitability of smallholder sugarcane farmers.

4.2.1 Profitability between Block Farming and Traditional Farming

Profitable smallholder sugarcane farming depends on the profits attained from the farming operations through an applicable farming system. Table 4.1 shows that there is a significant difference on profitability, measured as a ratio of operating income to revenue, between Block Farming System (M = 0.56, SD = 0.22) and Traditional Farming System (M = 0.39, SD = 0.23), t (36.57) = 4.23, p = 0.0001.

Table 4.1: Profitability by farming systems

			t-Test – Profitability by Farming Systems		
Group	Mean	Std. Dev.	df	t	p value
Block Farming	0.5551	0.2236			
Traditional Farming	0.3924	0.2256			
Difference	0.1627		36.5734	4.2322	0.0001

Histograms in Figure 4.1 show the comparative profitability density between BFS and TFS.

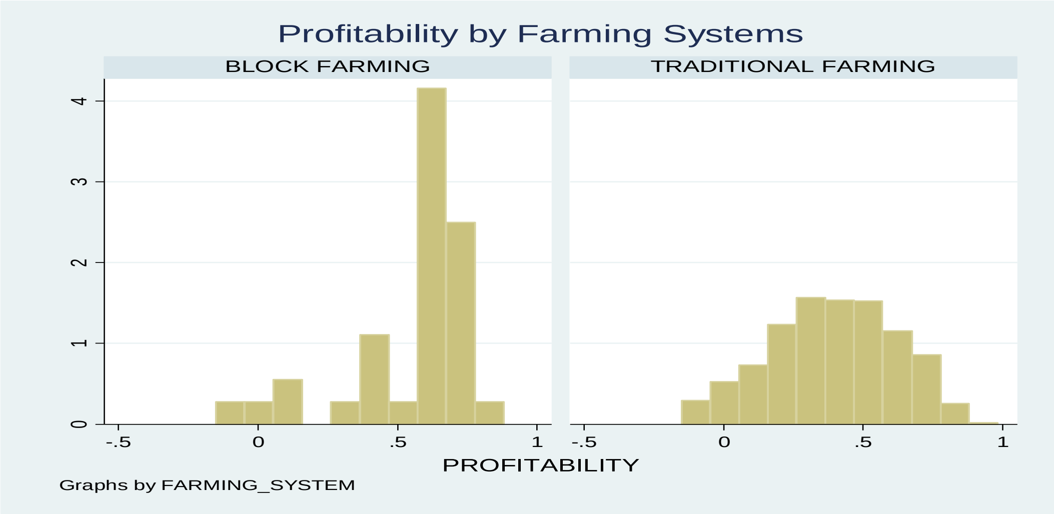


Figure 4.1 Histogram: Profitability by farming systems

4.2.2 Effect of Farming Systems on Profitability

Effectiveness of the farming systems into ensuring profitability of small holder sugarcane farming was assessed by comparing profitability by farming systems. Results of the one way ANOVA test in Table 4.2, revealed that there is a significant effect of the farming systems on the profitability, F (1, 1038) = 17.76, $p < 0.0001$.

Table 4.2: Effects of farming systems on profitability

. Oneway profitability farming_system, bonferroni

				Analysis of Variance	
Source	SS	df	MS	F	Prob>F
Between groups	0.895809	1	0.895809	17.76	0.0000
Within groups	52.359995	1038	0.050443		
Total	53.255804	1039	0.051527		

4.2.3 Hypothesis on the Effectiveness of the Farming Systems on Profitability

The profitability of the smallholder sugarcane farming systems was assessed by analyzing the ratio of the operating income to total revenue of the two farming systems. The hypothesis that Block Farming System (BFS) is not more effective than Traditional Farming System (TFS) into ensuring the profitability of the smallholder sugarcane farmers was tested. The results does not support the null hypothesis as it was revealed that there is a significant difference on the effectiveness of the farming systems on the profitability of smallholder sugarcane farmers. Profitability resulting from Block Farming (M = 0.56, SD = 0.22) is significantly higher than profitability attained through Traditional Farming (M = 0.39, SD = 0.23). Consequently, it is inferred that BFS is more effective than TFS into ensuring the profitability of the smallholder sugarcane farmers. Essentially, these results suggest that BFS is 17% more profitable than TFS and thus more effective into ensuring the profitability of the smallholder sugarcane farming.

Waswa et al., (2011) showed that contract sugarcane farmers in Lurambi, Koyonzo and Chemelil retained 32, 31 and 34% respectively, of gross income. The farmers in those three areas are traditional farmers and their gross profit is slightly less than the 0.39 (39%) realized by traditional farmers in the Kilombero valley as found in the current study. The 0.56 (56%) profitability attained through Block Farming System introduced in Tanzania suggest that the farming system is potential into assisting the smallholder farmers to uplift their economic and financial wellbeing. There are possibilities to improve further the profitability of smallholder sugarcane farmers practicing Block Farming through improved management controls and supervisions to ensure optimization of returns through cost reductions and yield improvement.

4.3 Impact of Hypothesized Factors on the Profitability of Farming Systems

Land size, yield, cost, sucrose content in sugarcane and price offered by the sugar processing factories are some of factors considered to have effects on the profitability of the smallholder sugarcane farming. An independent t-Test has been applied to assess the difference on these factors between the two smallholder farming systems. Spearman’s rank correlation test has been used to analyse the effects of the hypothesized factors on profitability of the farming systems. The causality of the hypothesized factors on the profitability was assessed by deploying the Tobit regression analysis.

Results and discussions on these tests are presented in the succeeding sections. The order of these presentations start with the results on the Tobit regression analysis and of the first order partial derivatives of the coefficients of the resulting Tobit models. This will be followed by the presentations of the results on differences of the factors hypothesized to affect the profitability between the farming systems. Then, results of the Spearman's rank correlation test deployed to analyses the association of each of the factors to the profitability by farming system will then ensue. Finally, discussions of these findings will be conducted.

4.3.1 Causality of Land Size, Yield, Sucrose, Price and Cost on Profitability

Tobit regression analysis was performed to assess the causal effects of the hypothesized factors on profitability of the farming systems. Two Tobit models, one for Block Farming System (BFS) and another for Traditional Farming System (TFS) were developed. In each of the two models the variables hypothesized to have causal effect on profitability (PROFIT) measured as a ratio of earnings before interest and tax (EBIT) to revenue, are land size (LAND) measured in hectare (ha), Sugarcane yield (YIELD) measured in tonnes per hectare (tch), sucrose content (SUCROSE) measured in percentage, price of one tonne of sugarcane (PRICE) in Tanzania Shillings (TZS) and total cost per hectare (COST) measured in TZS. The general mathematical model of the regression is as presented in Equation 23 in Chapter three.

However, since the coefficients of the predictor variables on the Tobit regression model cannot directly be interpreted as the effect of the independent variables on the dependent variable, (Amemiya, 1979), first-order partial derivative of the coefficients of the Tobit model have been calculated basing on Equation 28 in Chapter three presented by Mc Donald & Moffitt, (1980) to determine the causality of the hypothesized factors on the profitability of the farming systems.

The examination of the causality of the hypothesized factors on the profitability of Block Farming System revealed that there is a significant causal effect of the predictor variables on profitability, F (5, 30) = 201.38, $p < 0.0001$, as shown in Table 4.3. Consequently the resulting BFS Tobit regression model is as presented in Equation 30:

PROFIT = -0.0312 – 0.1383LAND + 0.1709YIELD – 0.0001SUCROSE + 0.6164PRICE – 0.5263COST + ε.…………………..……………….…………… (30)

Table 4.3: Causal effect of the predictor variables on profitability on BFS

Model	β	SE	t	Sig.(p)
Land size (sqrt)	- 0.1383	0.4699	- 0.29	0.771
Yield (sqrt)	0.1709	0.0143	0.96	0.000
Sucrose (sqr)	- 0.0001	0.0004	- 0.37	0.715
Price (log)	0.6164	0.0537	11.47	0.000
Cost (log)	- 0.5263	0.0249	- 21.06	0.000
Constant	- 0.0312	0.7157	- 0.04	0.966

Notes: Obs. summary: 2 left-censored observations 32 uncensored observations 1 right-censored observation at profitabil~y>=0.8.

F (5, 30) = 201.38
Prob>F = 0.0000
Pseudo R^2 is 25.5124
Log pseudolikelihood = 65.8668

To assess the causal effects of the posited factors on profitability, first-order partial derivative of Equation 28 in Chapter three presented by Mc Donald & Moffitt, (1980) has been applied. For the case of BFS, 32 observations out of 35 are uncensored and hence gave a ratio of 0.91. Therefore the required F(z) value for BFS is 0.91. Since the value of F(z) is greater than 0.5, the required area in the normal graph is obtained by subtracting 0.5 from the F(z) value which gives an area of about 0.41. This area gives a 'z' value of 1.37 and hence the corresponding f(z) = 0.16. Using these figures on Equation 28, the values of first-order derivatives for each of the variables were worked out and the outcome is as presented in Table 4.4

Table 4.4: First order partial derivative of Tobit model on BFS

Predictor variable	Transformation	printed β	β after back transformation	δEy/δXi
Land size	Reciprocal of square root	-0.14×10^{-1}	5.23×10^{1}	3.85×10^{1}
Yield	Square root	1.71×10^{-1}	2.92×10^{-2}	2.15×10^{-2}
Sucrose	Square	-1.42×10^{-4}	2.02×10^{-8}	1.49×10^{-8}
Price	Natural logarithm	6.16×10^{-1}	1.85×10^{0}	1.36×10^{0}
Costha	Natural logarithm	-5.26×10^{-1}	-5.91×10^{-1}	4.35×10^{-1}

The final model for the causal effect of the hypothesized factors on the profitability of the Block Farming System is constructed basing on the values of the first order partial derivatives but retaining the signs of the printed beta coefficients of the original Tobit model is as shown in Equation 31:

$$PROFIT = -3.12 \times 10^{-2} - 3.85 \times 10^{1} LAND + 2.15 \times 10^{-2} YIELD - 1.49 \times 10^{-8} SUCROSE + 1.36 \times 10^{0} PRICE - 4.35 \times 10^{-1} COST + \varepsilon \quad \ldots\ldots (31)$$

Likewise, as shown in Table 4.5, Tobit regression analysis on the causal effects of the predictor variables on the profitability of the Traditional Farming System have revealed that there is a significant effect of the variables on profitability, $F(5, 1000) = 1782.89$, $p < 0.0001$. The resulting Tobit regression model for the Traditional Farming System is as presented in Equation 32:

$$PROFIT = 0.9583 - 0.0109LAND + 0.1492YIELD - 0.0001SUCROSE + 0.5532PRICE - 0.5364COST + \varepsilon \quad \ldots\ldots (32)$$

Table 4.5: Causal effect of the predictor variables on profitability on TFS

Model	β	SE	t	Sig.(p)
Land size (sqrt)	- 0.0109	0.0044	- 2.45	0.014
Yield (sqrt)	0.1492	0.0025	60.29	0.000
Sucrose (sqr)	- 0.0001	0.0001	- 0.67	0.504
Price (log)	- 0.5532	0.0079	70.18	0.000
Cost (log)	0.5364	0.0061	-88.30	0.000
Constant	0.9583	0.0012	14.46	0.000

Notes: Obs. summary: 61left-censored observations 926 uncensored observations
18 right-censored observation at profitabil~y>=0.8.

$F(5, 1000) = 1782.89$
Prob>F = 0.0000
Pseudo R^2 is 21.7057
Log pseudolikelihood = 65.8668

Basing on Amemiya, (1979) assertion on the effects of the coefficients of Tobit model, the first-order partial derivative of Equation 28 presented by Mc Donald & Moffitt, (1980) was applied to deduce the causal effects of the hypothesized factors on the profitability of the Traditional Farming System (TFS). For the case of Traditional Farming 926 observations out of 1015 are uncensored which gives a ratio of 0.92. Therefore the required F(z) value for the TFS is about 0.92. Because the value of F(z) is greater than 0.5, the required area in the normal graph is obtained by subtracting 0.5 from the F(z) value which gives an area of about 0.42. This area gives a ‘z’ value of 1.41 and hence this gives the corresponding f(z) = 0.15. Using these figures on Equation 28 presented in Chapter three, the values of first-order partial derivatives for each of the predictor variables is worked out and the outcome is as presented in Table 4.6

Table 4.6: First order partial derivatives for predictor variables through TFS

Predictor variable	Transformation	printed β	β after back transformation	δEy/δXi
Land size	Recip. of sq. root	-1.09×10^{-2}	8.43×10^{1}	6.31×10^{1}
Yield	Square root	1.49×10^{-1}	2.22×10^{-2}	1.67×10^{-2}
Sucrose	Square	-5.1×10^{-5}	2.57×10^{-9}	1.92×10^{-9}
Price	Natural logarithm	5.53×10^{-1}	1.74×10^{0}	1.30×10^{0}
Costha	Natural logarithm	-5.36×10^{-1}	-1.71×10^{0}	1.28×10^{0}

The final model for the causal effect of the hypothesized factors on the profitability of the Traditional Farming System is constructed basing on the values of the first order partial derivatives but retaining the signs of the printed beta coefficients of the original Tobit model is as shown in Equation 33:

$$\text{PROFIT} = -\ 9.583 \times 10^{-1} - 6.31 \times 10^{1}\text{LAND} + 1.67 \times 10^{-2}\text{YIELD} + 1.30 \times 10^{0}\ \text{PRICE} - 1.92 \times 10^{-9}\ \text{SUCROSE} - 1.28 \times 10^{0}\text{COST} + \varepsilon \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (33)$$

4.3.2 Significance of Land Size on the Profitability of the Farming Systems

The size of the land used for sugarcane farming is crucial into ensuring profitable sugarcane farming. Land size is considered to be among the factors which have effect on the profitability of the smallholder sugarcane farming. An independent two sample t-Test reveals in Table 4.7 that land size differs significantly between Block Farming and Traditional Farming , t (1032.77) = -66.16, p = 0.0001. Specifically the summary statistics result in Table A.18 and Table A.19 in Appendix 2 suggests that land size used by smallholder sugarcane farmers practising Block Farming (M = 24.07 ha, SD = 1.79) is significantly higher than land size used by those practising Traditional Farming (M = 1.74 ha, SD = 1.58).

Table 4.7: T-Test - land size by farming systems

t-Test – Land size (in reciprocal of square root) by Farming Systems					
Group	Mean	Std. Dev.	df	T	p value
Block Farming	0.204	0.0095			
Traditional Farming	0.9655	0.3614			
Difference	-0.7615		1032.77	-66.1552	0.0000

4.3.3 Relationship between Land Size and Profitability

Assessment of the relationship between land size in (ha) and the profitability of the smallholder sugarcane farming systems was conducted by testing the correlation between land size used by smallholder sugarcane farmers and the profitability attained through the farming systems. Spearman's rank correlation test results in Table 4.8 revealed that correlation between land size and profitability through BFS is not statistically significant and have small effect size, $r(33) = 0.18$, $p = 0.30$. Squaring the correlation coefficient, and multiply it by 100 suggests that land size shared its variability with profitability by about 3 percent. In the case of TFS, the correlation between land size and profitability is statistically significant, $r(1003) = 0.40$, $p < 0.0001$. Land size shared variability with profitability by about 16 percent.

Table 4.8: Spearman's rank correlation between land size and profitability

. by farming_system, sort : spearman land size profitability, stats(p)	
-> farming_system = BLOCK FARMING	
Number of obs	35
Spearman's rho	0.1798
Test of Ho: land sizeha and profitability are independent	
Prob > |t|	0.3013
-> farming_system = TRADITIONAL FARMING	
Number of obs	1005
Spearman's rho	0.3974
Test of Ho: land sizeha and profitability are independent	
Prob > |t|	0.000

4.3.4 Causal Effect of Land Size on Profitability

The Tobit regression analysis result in Table 4.3, indicates that the coefficient of Land size (rsqrt) for sugarcane farmers practicing Block Farming is negative but not significant., $\beta = - 0.14$, $t = -0.29$, $p = 0.77$.Tobit regression results in Table 4.4 shows that the coefficient of Land size for sugarcane farmers practicing Traditional Farming is negative and significant., $\beta = -0.02$, $t = -2.45$, $p = 0.01$. However, since these results cannot be interpreted as the causal effects (Amemiya, 1979) of land size on profitability, the results of the first order partial derivative of the coefficient of land size suggest that for every unit increase in land size, profitability through Traditional Farming decreases significantly by 63.10 units. For the case of Block Farming, there is a non-significant decrease of about 38.50 units (one unit is equivalent to one thousandth percentage) on profitability for every unit increase in land size.

With these results, it can be envisaged that for smallholder sugarcane farming systems to bring the required profitability the farm must be increased to an optimum size. For the case of Traditional Farmers a small increase of land size that does not bring the farm to an optimum size could not be beneficial, whereas for the farmers practicing Block Farming, any increase that moves the land size away from an optimum size could have a negative effect on the farmers' profitability. It is therefore important for the smallholder farmers to increase and maintain their farms to an optimum size in order to optimize the profitability of the farming systems by increasing it through the benefits of economies of scales. The findings are consistent with Ken and Paulson, (2011) who asserted that an optimum land size is expected to enable efficient utilization of capital, machinery and labour.

4.3.5 Significance of Sugarcane Yield on Profitability

Sugarcane yield is among the critical determinants of the smallholder farming systems profitability. Yield is believed to be a key driver of profitability of smallholder sugarcane farmers. The result reported in Table 4.9 indicates that sugarcane yield achieved through Block Farming (BF) is not significantly higher than sugarcane yield achieved through Traditional Farming (TF); t (39.46) = 0.84, p = 0.41. Table A.18 and A.19 in Appendix 2 revealed that yield from BFS was (M = 56.7 tch, SD = 9.3) as compared to (M = 55.8 tch, SD = 13.6) from TFS.

Table 4.9: T-Test - yield by farming systems

t-Test – Yield (in square root) by Farming Systems					
Group	Mean	Std. Dev.	df	t	p value
Block Farming	7.5045	0.6258			
Traditional Farming	7.4125	0.9078			
Difference	0.0919		39.4616	0.8389	0.4066

4.3.6 Relationship between Sugarcane Yield and Profitability

Spearman's rank correlation test to assess the relationship between sugarcane yield per hectare and the profitability of the smallholder sugarcane farming systems revealed, as shown in Table 4.10, that correlation between yield and profitability through Block Farming is statistically significant, $r(33) = 0.43$, $p = 0.01$. The effect size of this relationship is moderate. Squaring the correlation coefficient, Spearman's rho (= 0.43), and multiply it by 100 revealed that sugarcane yield shared its variability with profitability by about 18 percent. In the Traditional Farming, the correlation between yield and profitability is statistically significant but with small effect size, $r(1003) = 0.15$, $p < 0.0001$. Squaring and then multiplying the

Spearman's rho (= 0.15) by 100 indicates that sugarcane yield shared its variability with profitability by about 2 percent.

Table 4.10: Spearman's rank correlation between yield and profitability

. by farming_system, sort : spearman yield profitability, stats(p)	
-> farming_system = BLOCK FARMING	
Number of obs	35
Spearman's rho	0.4281
Test of Ho: yield and profitability are independent	
Prob > |t|	0.0103
-> farming_system = TRADITIONAL FARMING	
Number of obs	1005
Spearman's rho	0.1454
Test of Ho: yield and profitability are independent	
Prob > |t|	0.0000

4.3.7 Causal Effect of Yield on the Profitability

Tobit regression analysis deployed to assess the causal effect of yield on profitability of the farming systems revealed, as shown in Table 4.3, that the coefficient yieldha, $\beta = 0.17$, $t = 11.96$, $p < 0.0001$ is positive and significant in the case of the Block Farming System. Likewise, Table 4.5 shows that the coefficient yieldha is positive and significant through Traditional Farming System, $\beta = 1.5$, $t = 60.29$, $p < 0.0001$,

Basing on Equation 28, the first-order partial derivative value for the predictor variable Yieldha in Table 4.4 shows that for every unit increase in sugarcane yield through Traditional Farming System, profitability increases significantly by 1.67×10^{-2} units. Table 4.4 shows that profitability through Block Farming increases significantly by 2.15×10^{-2} units. This result agrees with the findings reported by Directorate General for Agricultural, (2000) which mentioned yield as a key factor for farmers' profitability expectations and results. Likewise the outcome agrees with the findings reported by Masuku, (2011) and Dlamini & Masuku, (2013) which had revealed that yield is one of key determinants of farmers' profitability.

4.3.8 Significance of Sucrose Content on Profitability

Sucrose content in sugarcane is one of the essential determinants of the profitability of the farming systems. This is from the fact that determination of sugarcane price is based on the amount of sucrose content. The result in Table 4.11 revealed a non-significant difference on the sucrose between BFS and TFS, *t* (38.06) =1.55, *p* = 0.13. Table A.18 and A.19 in Appendix 2 shows that sucrose from Block Farming was (*M* = 10.05 percent, *SD* = 0.84) as compared to (*M* = 9.79 percent, *SD* = 1.09) achieved from Traditional Farming.

Table 4.11: T-Test - sucrose by farming systems

	t-Test – sucrose (in natural logarithm) by Farming Systems				
Group	Mean	Std. Dev.	df	t	p value
Block Farming	101.5994	16.9851			
Traditional Farming	97.0559	21.3355			
Difference	4.5435		38.0608	1.5508	0.1316

4.3.9 Relationship between Sucrose Content and Profitability

Spearman's rank correlation test to assess the relationship between sucrose and the profitability of the smallholder sugarcane farming systems revealed, as shown in Table 4.12, a non- significant correlation between sucrose and profitability through Block Farming system, *r*(33) = 0.11, *p* = 0.51. The effect size of this relationship is low. Squaring the correlation coefficient and multiply it by 100 revealed that sucrose shared its variability with profitability by about 1 percent. In the case of Traditional Farming, the correlation between sucrose and profitability is statistically significant, *r*(1003) = 0.11, *p* < 0.0003. Sugarcane yield shared its variability with profitability by about 1 percent.

Table 4.12: Spearman's rank correlation between sucrose and profitability

. by farming_system, sort : spearman sucrose profitability, stats(p)	
-> farming_system = BLOCK FARMING	
Number of obs	35
Spearman's rho	0.1144
Test of Ho: sucrose and profitability are independent	
Prob > |t|	0.5130
-> farming_system = TRADITIONAL FARMING	
Number of obs	1005
Spearman's rho	0.1141
Test of Ho: sucrose and profitability are independent	
Prob > |t|	0.0003

4.3.10 Causal Effect of Sucrose on the Profitability

The result of the Tobit regression analysis in Table 4.3 revealed that the coefficient of the variable sucrose, $\beta = -1.4 \times 10^{-4}$, $t = -0.37$, $p = 0.715$, is negative and non - significant through Block Farming System. In the case of Traditional Farming, the result in Table 4.5, shows that the coefficient of the variable sucrose: $\beta = -5.1 \times 10^{-5}$, $t = -0.67$, $p = 0.504$ is negative but not significant. The first-order partial derivative results in Table 4.4 reveals that every unit increase in sucrose through Block Farming has a non-significant decrease of about 1.49×10^{-8} on the profitability. As indicated in Table 4.6 a unit increase of sucrose through Traditional Farming resulted in a non-significant decrease of about 1.92×10^{-9} in profitability. These results were not expected because an increase in sucrose is expected to increase price of sugarcane, and subsequently the profitability of the farming system.

Studies by Masuku (2011) and Dlamini & Masuku (2013) have mentioned sucrose to have significant ($p < 0.01$) influence on profitability of sugarcane farming. It was also expected in this study that sucrose could have a significant effect on profitability through both sugarcane farming systems. There have been some complaints on the way sucrose is determined among sugarcane farmers in Kilombero in recent years. Likewise a quick look on a number of payment vouchers had revealed a turbulent trend whereby different prices for the same sucrose content were noted during the same period. This calls for a separate critical study.

4.3.11 Significance of Sugarcane Price on Profitability

For the smallholder sugarcane farming to be profitable, price of sugarcane per tonne must be sufficient to ensure a sustainable profit is earned from the farming operations. Thus price of sugarcane is considered one of the key determinants of the profitability of the farming systems. A Study of the difference of sugarcane price between the farming systems shows, as presented in Table 4.13, that sugarcane price attained in Block Farming is significantly different, t (46.80) = 11.80, $p < 0.0001$ to the price realized in Traditional Farming. Table A.18 and Table A.19 in Appendix 2 shows that price of a tonne of sugarcane in Tanzania Shillings (TZS) earned through Block Farming (M = 61274.60, SD = 1258.63) is significantly higher than the price earned through Traditional Farming (M = 48269.23, SD = 396.42).

Table 4.13: T-Test - sugarcane price per tonne in natural logarithm of TZS

t-Test – Price in natural logarithm by Farming Systems					
Group	Mean	Std. Dev.	df	t	p value
Block Farming	11.0157	0.1281			
Traditional Farming	10.7480	0.2793			
Difference	0.2677		46.8045	11.4508	0.0000

4.3.12 Relationship between Sugarcane Price and Profitability

Spearman's rank correlation test to assess the relationship between sugarcane price and the profitability of the smallholder sugarcane farming systems revealed, as shown in Table 4.14, that there is a significant correlation between price and profitability through Block Farming with moderate effect size, $r(33) = 0.48$, $p = 0.004$. Squaring the correlation coefficient and multiply it by 100 revealed that sugarcane price shares its variability with profitability by about 23 percent. In the case of Traditional Farming, the correlation between price and profitability is statistically significant with low effect size, $r(1003) = 0.20$, $p < 0.0001$. Price shared its variability with profitability by about 4 percent.

Table 4.14: Spearman's rank correlation between price and profitability

. by farming_system, sort : spearman price profitability, stats(p)	
-> farming_system = BLOCK FARMING	
Number of obs	35
Spearman's rho	0.4805
Test of Ho: price and profitability are independent	
Prob > |t|	0.0035
-> farming_system = TRADITIONAL FARMING	
Number of obs	1005
Spearman's rho	0.2035
Test of Ho: price and profitability are independent	
Prob > |t|	0.0000

4.3.13 Causal Effect of Sugarcane Price on the Profitability

Results of the Tobit regression analysis in Table 4.3, revealed that in the case of Block Farming, the coefficient of the predictor variable price, $\beta = 0.62$, $t = 11.47$, $p < 0.001$ is positive and significant. Likewise for the case of Traditional Farming, the result in Table 4.5 shows that the coefficient of the variable price, $\beta = 0.55$, $t = 70.18$, $p < 0.001$ is positive and significant. Results of the first order partial derivative for the variable price indicated in Table 4.4 shows that for a unit increase in price there is an increase of about 1.36 units on profitability through Block Farming System. Table 4.6 shows that a unit increase in price through Traditional Farming results in about 1.30 units (in thousandth of percentage) increases on profitability.

Principally these results suggests that price of sugarcane per tonne is one of the fundamental determinant of a profitable smallholder sugarcane farming. Similar results were reported by the Directorate General for Agricultural, (2000) who mentioned market price as one of the key determinants of farmers' profitability. Likewise, a study by Dlamini & Masuku (2013) has mentioned price to have significant effect on smallholder sugarcane farmers' profitability. It is therefore imperative to ensure price of sugarcane agreed between Millers and farmers is adequate to absorb all the costs and leave the farmers with enough profit.

4.3.14 Significance of Cost on Profitability

Sugarcane farming involves a number of costs, fixed and variable, to enable realization of the required product. These costs affect the profitability of the smallholder sugarcane farming. The higher the cost, the lower the profit realized. In this study a total of pre-harvest and post-harvest cost per hectare was analysed to assess its effects on the profitability of the smallholder sugarcane farmers attained from Block Farming and Traditional Farming systems respectively. The result in Table 4.15 of the two sample t-Test with unequal variance, t (36.46) = -0.42, p = 0.68, revealed that there is no significant difference on the cost per hectare between the two farming systems. Summary statistics presented in Table A.18 and Table A.19 in Appendix 2 shows that cost per hectare (in TZS) through the Block Farming system, (M = 1,507,257.00, SD = 640,876.70) is not significantly less than cost incurred through Traditional Farming system (M =1,545,989.00, SD = 707,356.20).

Table 4.15: T-Test - cost/ha in natural logarithm of TZS by farming systems

t-Test – Cost in natural logarithm by Farming Systems					
Group	Mean	Std. Dev.	df	t	p value
Block Farming	14.1283	0.4687			
Traditional Farming	14.1619	0.4608			
Difference	-0.0336		36.4618	- 0.4177	0.6786

4.3.15 Relationship between Cost and Profitability

Spearman's rank correlation test to assess the relationship between cost and the profitability of the smallholder sugarcane farming systems reveals, as shown in Table 4.16, that there is a significant correlation between total cost per hectare and the profitability through Block Farming, $r(33) = 0.89$, $p < 0.0001$. The effect size of this relationship is high. Squaring the correlation coefficient, Spearman's rho (= 0.89), and multiply it by 100 revealed that sugarcane cost shared its variability with profitability by about 79 percent. In the case of Traditional Farming, the correlation between cost and profitability is statistically significant, $r(1003) = 0.67$, $p < 0.0001$. The size of the effect is high. Squaring and multiplying the Spearman's rho (= 0.67) by 100 indicates that cost per tonne shared its variability with profitability by about 44 percent.

Table 4.16: Spearman's rank correlation between cost and profitability

. by farming_system, sort : spearman cost profitability, stats(p)	
-> farming_system = BLOCK FARMING	
Number of obs	35
Spearman's rho	0.8880
Test of Ho: cost and profitability are independent	
Prob > |t|	0.0000
-> farming_system = TRADITIONAL FARMING	
Number of obs	1005
Spearman's rho	0.6658
Test of Ho: cost and profitability are independent	
Prob > |t|	0.0000

4.3.16 Causal Effect of Costs on the Profitability

As indicated in Table 4.3, Tobit regression results on the Block Farming System revealed that the coefficient of the predictor variable cost per hectare, costha, $\beta = -0.53$, $t = -21.06$, $p < 0.001$, is negative and significant. Similarly, the results in Table 4.5 shows that costha, has a negative and significant coefficient on the Traditional Farming model, $\beta = -0.54$, $t = -88.30$, $p < 0.001$.

First-order partial derivative results in Table 4.4 revealed a decrease of about 0.44 units on the profitability for every unit increase on cost through Block Farming. Table 4.6 showed that a unit increase of cost through Traditional Farming reduces the profitability of the farming systems by about 1.28 units. This finding agrees with the finding reported by Directorate General for Agricultural, (2000) which has mentioned cost to be the second most important factor after yield in the expectation and results of profitability to majority of farmers.

4.3.17 Summary of the Results and Discussions on the Factors of Profitability

In this section a summary of the findings and discussions on the influence of the hypothesized factors on the profitability of the smallholder sugarcane farming systems are presented. The summary comprising of the results and discussions presented from section 4.2.1 through section 4.2.16 have been broken down into five subsections each covering one of the hypothesized factors namely, land size, sugarcane yield, sucrose content in sugarcane, price of sugarcane per tonne and total cost incurred per tonne of sugarcane produced and sold to the Sugar Processing Company.

4.3.17.1 Influence of Land Size on Profitability

From the results and discussions presented in section 4.2.1 to 4.2.4, it has been noted that there is a significant difference on land size between the two farming systems. An association between land size and profitability was found to be significant on Traditional Farming System but non-significant on the Block Farming System. The effect size of correlation between profitability and each of the two farming systems as indicated by the Spearman's rho was found to be small. Causality of land size on the profitability was found to be non-significant on the BFS, but significant on TFS. The results obtained are consistent with results reported by Ken &, Nick, (2011) who asserted that optimum land size enable efficient utilization of capital, labour and machinery which are also critical determinants of farmers profitability.

4.3.17.2 Influence of Sugarcane Yield on Profitability

It is also evident from the results and subsequent discussions in section 4.2.5 to 4.2.7 that there is no significant difference on sugarcane yield between BFS and TFS. However, Spearman's correlation test revealed a significant association between sugarcane yield per hectare and the profitability of the farming systems. The effect size was moderate in the case of BFS and small in the case of TFS. Causal effect of yield on profitability was found to be positive and significant in both BFS and TFS. These results are consistent with the findings reported by the Directorate General for Agricultural, (2000); Masuku, (2011) and Dlamini & Masuku (2013) who had indicated yield as a key determinant of profitability among farmers.

4.3.17.3 Influence of Sucrose Content on Profitability

Results and discussions reported in section 4.2.8 to 4.2.10, revealed a non-significant difference on sucrose between the two farming systems. An association between sucrose and profitability was found to be non-significant on the Block Farming System. The association through Traditional Farming was found significant. The effect size of correlation between the sucrose content and the profitability on each of the two farming systems was found to be small. Causal effect of sucrose on the profitability was found to be negative and non-significant on both BFS and TFS. These results are not consistent with the findings reported by Masuku, (2011) and Dlamini & Masuku, (2013) who had mentioned sucrose to have significant ($p < 0.01$) influence on profitability of sugarcane farming. The findings of this study were not anticipated because higher sucrose content was expected to cause higher sugarcane price per tonne and eventually profitable smallholder sugarcane farming.

4.3.17.4 Influence of Sugarcane Price on Profitability

Contrary to expectations, the results and discussion reported in section 4.2.11 through 4.2.13 indicated that there is a significant difference on sugarcane price between BFS and TFS. Spearman's rank correlation test revealed a significant association with moderate effect size between sugarcane price and the profitability of the Block Farming System. However, the association between sugarcane price and the profitability of the Traditional Farming System was found to be non-significant and with small effect size. The causal effect of price on both TFS and BFS were found to be significant. These outcomes are consistent with the Directorate General for Agricultural, (2000) report which had mentioned price as a key determinant of profitability. The results are also consistent with the findings reported by Dlamini & Masuku, (2013) that price have significant effect on smallholder sugarcane farmers' profitability.

4.3.17.5 Influence of Costs on Profitability

As it was expected, cost has significant effect on the profitability of the smallholder sugarcane farming systems. Results and discussions reported in section 4.2.14 to 4.2.16, revealed a non-significant difference on cost between the two farming systems. An association between cost and profitability was found to be significant on both Block Farming System and Traditional Farming System. The effect size of the correlation between total cost and the profitability was found to be high on the BFS and moderate on TFS. Causal effect of cost on the profitability on both BFS and TFS was found to be negative and significant This finding agrees with the Directorate General for Agricultural, (2000) report which had mentioned cost to be one of the most important factor in the expectation and results of profitability to majority of farmers.

4.3.18 Hypothesis on the Factors of the Profitability

The first hypothesis of this comparative study of the profitability of the smallholder sugarcane farming systems sought to find if there is any significant difference on the factors of profitability between Block Farming System and Traditional Farming System. The results reported and discussed in Section 4.2.1 to section 4.2.17 had revealed that there are significant difference on effects and causality of the hypothesized factors on the profitability of the farming systems. The null hypothesis is therefore rejected and it is inferred that there are significant differences on the factors affecting the profitability of the smallholder farming systems.

4.4 Effect of Profitability on Loan Repayment

This final section of the results and discussion chapter is concerned with the third specific objective of this study which pursues to assess the effects of the profitability of the smallholder sugarcane farming systems on loan repayment rate. This objective is linked to the third hypothesis of the study which pursues to find if there is any significant effect of the profitability of the farming systems on loan repayment rate.

4.5 Loan Repayment Rate

Table 4.17 indicates that loan repayment rate achieved through Block Farming System (*M* = 0.96, *SD* = 0.05) exceeded by about 20 percent the repayment rate through Traditional Farming System (*M* = 0.76, *SD* = 0.26).

Table 4.17: Loan repayment rate by farming systems

	. by farming_system, sort : summarize loan_repayment				
		-> farming_system = BLOCK FARMING			
Variable	Obs	Mean	Std. Dev.	Min	Max
Loan repayment	9	0.9611	0.0486	0.9	1
		-> farming_system = TRADITIONAL FARMING			
Variable	Obs	Mean	Std. Dev.	Min	Max
Loan repayment	70	0.7621	0.26251	0	1

4.6 Hypothesis on the Effect of Profitability on Loan Repayment

The third hypothesis of this study is linked to the third objective and pursues to find if there is any significant effect of the profitability of the farming systems on loan repayment rate. Loan repayment rate was calculated as a ratio of the amount of loan repaid timely to the total loan amount. The Spearman's rank correlation test results in Table 4.18 reveals a significantly high correlation on the BFS (spearman's' rho = 0.84, $p < 0.004$) and similarly a significantly high correlation on the TFS, (spearman's' rho = 0.79, $p < 0.0001$). The null of the third hypothesis is thus rejected and consequently it is inferred that there is a significant effect of the profitability of the smallholder sugarcane farming systems on loan repayment rate.

Table 4.18: effect of profitability on loan repayment

. by farming_system, sort : spearman's profitability loan_repayment, stats(p)	
-> farming_system = BLOCK FARMING	
Number of obs	9
Spearman's rho	0.8420
Test of Ho: loan repayment and profitability are independent	
Prob > |t|	0.0044
-> farming_system = TRADITIONAL FARMING	
Number of obs	70
Spearman's rho	0.7942
Test of Ho: loan repayment and profitability are independent	
Prob > |t|	0.0000

The BFS loan repayment rate of 0.96 (96%) indicates a loan repayment delinquency of about 4% among the smallholder farmers practicing the system, whereas the repayment rate through TFS with a mean of 0.76 (76%) shows a loan repayment delinquency/default of about 24% which Compares favourably with the findings reported by Magali, (2013) who reported a loan default rate of 22% in Tanzania. The implication of this findings suggests that the higher profitability of BFS has significantly reduce the loan repayment deliquency/default by about 20% as compared to TFS. The results agrees also with the findings reported by Ayanda & Ogunsekan, (2012) who have reported that an increase in the size of the farm leads to a higher potential to repay loans due to higher level of income caused by increased production.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Overview

In this final chapter of the manuscript of the comparative study of the profitability of the smallholder sugarcane farming systems in Tanzania, conclusion on the outcome of the study is presented. The chapter comprises of the conclusions on empirical findings, theoretical implications, policy implications, general recommendations, recommended generic model for future studies of profitability and loan repayment of farming systems, and recommendations for further studies. The chapter also provides a summary of major contributions of the study including a new formula developed and recommended for calculations of interest rate to be charged by financial intermediaries to its borrowers. The chapter starts by highlighting limitations of the study and is finalized by giving a summary of the conclusions.

5.2 Limitations of the Study

The study was conducted in a very good environment where all participants were very cooperative into offering the required answers as per the survey questions. However, some of the smallholder farmers do not keep proper financial records of the farming operations, in particular the pre-harvest costs. Fortunately, they were able to give a range of yearly pre-harvest costs which were found to match with yearly estimated costs obtained from the Kilombero Sugar Company Outgrowers Services Department. Post-harvest costs were accurate as they were recorded from the payment vouchers obtained from the smallholder farmers and from the Finance department of the Kilombero Sugar Company. Basing on these limitations, the lower limit of the tobit model was set to be zero with an arbitrary assumption that the revenue earned by the small holder farmers will be equal to total cost incurred. The upper limit was set to 0.8 with an arbitrary assumption that the farmers will spend at least 20% of the generated revenue to finance various farming operations.

5.3 Empirical Findings

5.3.1 Profitability of the Smallholder Sugarcane Farming Systems

An effective farming system is the one that can generate sustainable financial gain through profitable operations among the smallholder farmers and ensure betterment of their welfare. In the bid to improve the efficiency of smallholder sugarcane farmers in Tanzania, Block Farming System (BFS) was introduced in 2006 to replace or complement the Traditional Farming System (TFS) which is considered to be inefficient. The introduced smallholder farming system is expected to improve the profitability of the smallholder sugarcane farmers by taking rewards of economies of scale through collective management of various inputs and by overcoming the impediments of fixed cost per unit infrastructure investment, (Basimwaki et al., 2007; (Rugaimukamu et al., 2007).

This study attempted to assess the profitability of the smallholder sugarcane farming systems through comparative analysis between BFS and TFS. One way analysis of variance (ANOVA), two sample t-Test, Spearman's rank correlation test and Tobit regression analysis, all at the significance level of 0.05, have been applied to assess effects, differences, associations and causal effects of the hypothesized factors namely land size, yield, sucrose, price and cost, on the profitability of the smallholder farming systems. The association between profitability and loan repayment performance has also been examined to determine if there is any significant effect of the profitability of the farming systems on loan repayments.

Effects of the farming systems on profitability were found to be significant. There is also a significant difference on the profitability of the two farming systems. The profitability attained in each of the two farming systems was calculated as the ratio of the operating income (EBIT) to the total revenue earned by the smallholder sugarcane farmers. Profitability of the BFS (M = 0.56, SD = 0.22) is significantly higher than the profitability of TFS (M = 0.39, SD = 0.23). The meaning of this is that farming through BFS is 17% more profitable than TFS.

Basing on the second specific objective of this study, the second hypothesis sought to find if there is any significant difference on the profitability between BFS and TFS. The findings suggest a rejection of the null hypothesis and it is thus concluded that BFS is significantly more effective than TFS into ensuring the higher profitability.

5.3.2 Effects of Land Size, Yield, Sucrose, Price and Cost on the Profitability of the Smallholder Sugarcane Farming Systems

The effect of land size on the profitability has a non-significant small size on BFS, whereas the effect size is significant and moderate on the TFS. There is a significant difference on land size between BFS (M = 24.07 ha) and TFS (M = 1.74 ha). The causal effect of land size on the profitability on BFS was found to be negative and non-significant while it was negative and significant on the TFS. The implication of this finding is that for smallholder farming systems to be profitable, the land used should have an optimum size. A small increase of land size used in BFS might result into a negative effect on the profitability. On the other hand, a small increase on land in the case of TFS that does not bring the farm to an optimum land size will cause a significant negative effect on the profitability. It is therefore concluded that use of an optimum land size is a key driver of profitability of the smallholder farming systems.

It is also concluded that crop yield is a key determinant of profitability of the farming systems. Effect size of yield on profitability was found to be significant and moderate on BFS while it was significant and small on TFS. Causal effect of yield on the profitability was found to be significant on the two farming systems. Every unit increase on yield per hectare on BFS and TFS have significant positive effect on the profitability. Smallholder farmers and other stakeholders should therefore focus into improving crop yields to sustain their profitability.

Quality of crops, in the context of this study sugarcane sucrose, is an important determinant of the profitability of the farming systems. Sucrose is a measure of the amount of sugar in a volume of extracted sugarcane juice. Sugarcane with high sucrose content attracts high sugarcane price per tonne. Sucrose content attained on BFS (M = 10.05 percent) was found to be not significantly higher than sucrose content realized on TFS (M = 9.98 percent). There was also a non-significant low effect size of sucrose on the profitability of the two farming systems. Causal effect of a unit increase of sucrose on the profitability was found to be non-significant and decreasing on both BFS and TFS. This result was unexpected because increase on sucrose content was expected to increase the farmers. revenue due to higher price and eventually increase positively the profitability of the small holder farmers.

Price of one tonne of sugarcane basing on the sugarcane quality measured by the percentage of sucrose content in sugarcane has proved to be among the key determinants of the profitability of the smallholder sugarcane farming systems. Price of sugarcane attained through BFS (*M* = TZS 61,274.60) was found to be significantly higher than price attained through TFS (*M* = TZS 48,269.23). This difference is attributed by the difference on sucrose content which was also found to be higher on BFS. The relationship between price and profitability of the farming systems was also found to be significant on both BFS and TFS. However, the effect size of this relationship was moderate on BFS while it was low on TFS. Causality of price on the profitability was also found to be slightly higher per unit increase on BFS (1.36) than on TFS (1.30).

Cost has significant negative effect on the profitability of the smallholder sugarcane farming systems. However, there is no significant difference between the cost per hectare on BFS (*M* = TZS 1,507,257) and TFS (*M* = TZS 1,545,989). The effect size of the correlation between cost and the profitability was found to be high on the BFS and moderate on TFS. Causality of cost on the profitability was found to be significant on the BFS with small decrease in profitability (0.44) per unit increase in cost. On the TFS every unit increase on cost reduces the profitability by about 1.28 units. These results suggest that a unit increase in cost on the TFS has a higher negative effect on the profitability than on BFS. It can therefore be deduced that BFS offers a higher profitability than TFS owing to the significantly lower causal effect of any unit increase on cost.

Based on the first specific objective, the first hypothesis of this study pursue to find if there is any significant difference on the effects of hypothesized factors on the profitability of the smallholder sugarcane farmers between Block Farming System and Traditional Farming System. The outcome of the study revealed significant differences on effect of each hypothesized factors on the profitability of the farming systems. Consequently the null hypothesis is rejected and it is concluded that there are significant differences on the effects of land size, crop yield, sucrose, selling price and total operating cost on the profitability of the smallholder farming systems.

5.3.3 Effect of Profitability on Loan Repayment

The third specific objective of the study was to assess if there is any significant effect of profitability of the smallholder farming systems on loan repayment rate. This objective is linked to the third hypothesis with its null stating that there is no significant effect of profitability on loan repayment rate. The outcome of the assessments revealed that there is a high association between loan repayment rate and profitability. The size of effect on the BFS was higher than on TFS. The null of the third hypothesis is thus rejected and inferred that there is a significant effect of the profitability of the farming systems on loan repayment rate. BFS had proved to have higher profitability (M = 0.56) and higher loan repayment rate (M = 0.96) as compared to profitability on TFS (M = 0.39) and loan repayment rate (M = 0.76).

The findings on loan repayment rate suggest a 20% difference between BFS and TFS. Also the findings suggest that there was only about 4% loan repayment delinquency/default through BFS as compared to a loan repayment delinquency/default of about 24% through TFS. The loan repayment delinquency/default through TFS compares favourably with loan repayment default of 22% in Tanzania reported by Magali, (2013). Therefore BFS has proved to be more effective into ensuring higher loan repayment rates and consequently reducing loan repayment delinquency among smallholder farmers in the country.

5.4 Theoretical Implication

The study was set to comparatively assess the profitability of the BFS which is based on the network theory of coordination (cooperative and corporate coordination) and profitability of the TFS which is based on the hierarchies' coordination theory (full ownership integration).The two theories which forms part of the General Systems Theory were presented by Rehber, (2006). Basing on the neoclassical micro economic theory the main objective of a commercial entity like sugarcane farming is to maximize profit.

The outcome of this study has revealed that BFS which falls under the cooperative farming society is more effective than individualized TFS into maximizing the profitability of smallholder sugarcane farmers. BFS has also proved to be significantly more effective than TFS on loan repayment performance. With this regard, it is argued that application of the network coordination theory to the smallholders farming societies is more ideal than hierarchies' theory of coordination when it comes to maximizing profits and attains sustainable profitable farming which also ensures effective loan repayments.

5.5 Policy Implications

Agriculture and Livestock Policy, (URT, 1997) provides that the ultimate goal of the policy is the improvement of the welfare of the people whose principal occupation and way of life is based on agriculture. However, the current policy need to be reviewed to encourage cooperative or joint farming societies like BFS which appear to be more effective than TFS into ensuring higher profitability as well as higher loan repayment rate among smallholder farmers.

It is also recommended that the government should review the policy (Agriculture and Livestock Policy), and through its machineries, formulate and enact a new Tanzania Agricultural Loan Act (TALA) which should provide a framework to initiate loan guarantee schemes for smallholder farmers and agricultural co-operatives. Farmers can use these loans to establish and develop farms while agricultural co-operatives may access loans to process farm products for value additions, distributions or marketing of the farming products.

The proposed TALA should make provisions for the introduction of Tanzania Farm Service Agency (TFSA) which should be tasked to facilitate government guarantee to lenders repayment of up to 95% of net loss on eligible loans issued in case of natural disasters like flood, drought or quarantine as well as subsidy to smallholder farmers/traders. TALA and TFSA should be among the policy instruments of the Agriculture and Livestock Policy.

In the current study it was found out that yield is among the important factors of profitability of smallholder sugarcane farmers. This outcome is also very relevant in other industries of the crop subsector. It is therefore recommended that the Agriculture and Livestock Policy, (URT, 1997), be reviewed to put emphasis on research and introduction of high yield - high quality varieties that will boost the profitability of smallholder farmers.

In order to mitigate lending risks and facilitate effective loan repayment control, the National Microfinance Policy should also be reviewed to encourage group lending. The borrowers should be motivated to form groups basing on their trade or business functions. For example, smallholder farmers should be encouraged to form joint farming societies like block farming. It is anticipated that through group lending the loan transaction cost will be reduced and risk of loan default will also be reduced. These will enable microfinance institutions to charge low interest rates. The low interest rates will enhance the profitability of smallholder farmers and eventually ensure a profitable smallholder farming.

5.6 General Recommendations on Profitability of the Farming Systems

Although profitability of Block Farming System has been found to be 17% more than the profitability of the Traditional Farming System it is worth to consider the following points in order to enhance and optimize return among smallholder sugarcane farmers:

i. Optimum size of block farm should be determined to optimize returns to members (current block farms have size ranging between 20 to 30 hectares).
ii. Reason for the drop of yield in block farms should be investigated.
iii. A more appropriate mechanism to measure sucrose content in sugarcane must be introduced and must be managed by a third party to ensure fairness.
iv. Smallholder farmers in the country, should be trained, encouraged and assisted to form more block farms as they have proved to be more effective into ensuring profitability and higher loan repayment.

5.7 Recommended Model for Further Studies

5.7.1 Farm Systems Profitability Model – (FSP-M)

As part of creativity, a new generic model presented in Figure 5.1 has been developed in the course of this study and is recommended for future analyses of profitability and loan repayment of smallholder and corporate farming systems. The model is standard for all crops. The features of the developed FSP-M model are presented in section 5.7.1.1 to 5.7.1.5.

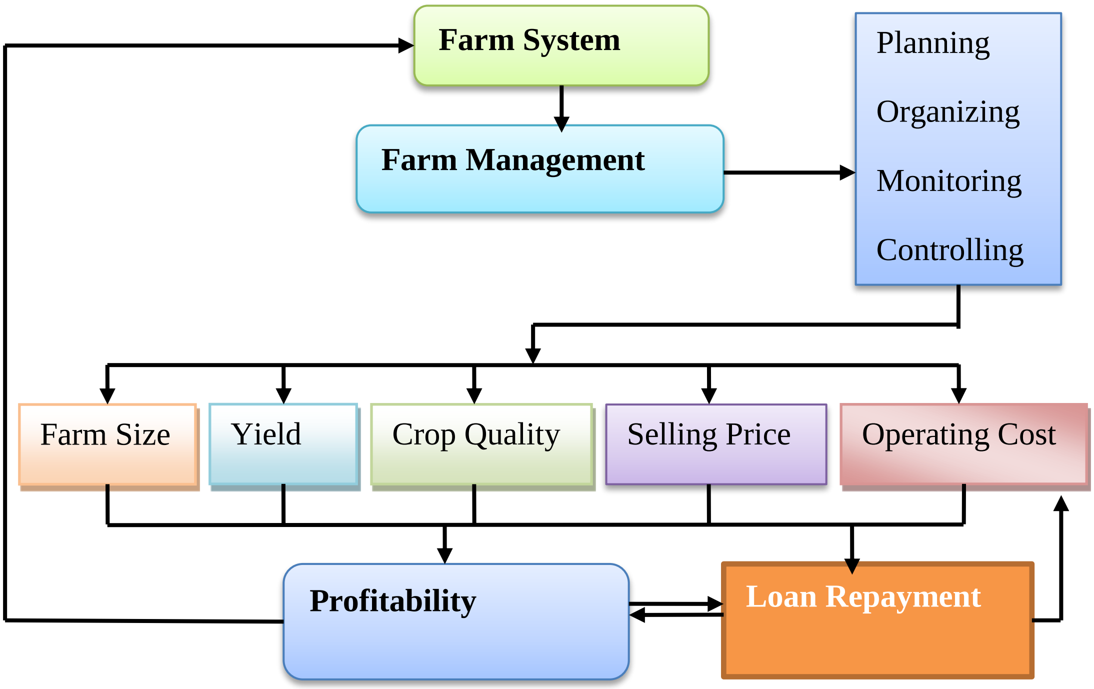


Figure 5.1: Farm systems profitability model (FSP-M)

5.7.1.1 Farm Systems

Smallholder farming profitability and loan repayment performance depends on various factors but more so on the farming systems used basing on the general system theory reported by Rehber, (2006). The farming systems, which are the independent variables, can fall under any of the three main theories of coordination namely; hierarchies (full ownership integration), markets (open market integration) and networks (cooperative and corporate coordination).The model can be used to assess one farm system or comparatively assess two or more farming systems.

5.7.1.2 Farm Management

Farm management plays an important role on the profitability of farming systems by aiming to maximize financial profitability. An applicable farming system is expected to facilitate effective management of the farm activities through the traditional management roles of planning, organizing, controlling, and monitoring.

5.7.1.3 Drivers of Profitability

Five key factors, namely farm-size, crop-yield, crop-quality, selling-price and total operating-cost make an important integral part of the recommended model. Correlation and causality of these factors on the profitability should be analysed to examine their relation and causal effects on the respective farming system.

5.7.1.3.1 Farm Size

Farm size plays an important role into enhancing profitability among farmers. Through an effective farming system an optimum farm size can be set up and managed appropriately to take advantages of economies of scale. Ken and Paulson, (2011) reported that farm size affect profitability due to a number of factors, including complexities of management decisions by farm operators. They mentioned that profitability in large farms may be enhanced due to increasing return to scale or by expanding the scale of operations. They also mentioned that large farms may be able to more efficiently use larger equipment complements and obtain discounts by buying larger volumes of inputs.

5.7.1.3.2 Crop Yield

High crop yield is expected to bring in more revenue given a particular selling price. Consequently, the achieved high revenue is expected to bring in high profitability which if sustainable will result into a profitable farming operation. An effective farming system is perceived as a key driver of high crop yields. However, other factors like variety, weather and agronomic factors can also affect crop yield.

5.7.1.3.3 Crop Quality

Crop quality is a key determinant of achieving profitability of smallholder farmers. A better quality farm produce is expected to attract a superior selling price and hence higher profit as compared to inferior quality crop. It therefore seems reasonable to include crop quality as one of key determinant of profitability of farming systems.

5.7.1.3.4 Selling Price

Through an effective farm system, farm management will be able to introduce value addition measures and also to negotiate lucrative selling prices. Through fair price that absorbs all the operating cost and leave the smallholder farmers with reasonable profit, the farmers will be able to achieve a profitable farming that will eventually improve their economic wellbeing.

5.7.1.3.5 Operating Cost

Operational cost can be controlled through an efficient and effective farm management. Operating cost in the context of the recommended model involves both pre-harvest and post-harvest costs. The fixed cost associated with acquisition of the land can also be included. It is expected that through effective and efficient farm management, the operating costs will be managed appropriately in order to ensure an optimum financial returns to the smallholder farmers.

5.7.1.4 Profitability

If sustainable, profitability enables an organization to contain its operations over a long term. Commercial farms are organizations in their own rights. Through the profitability of the farming systems, a smallholder farmer is expected to have sustainable farming operations which will also enable effective repayment of loans.

5.7.1.5 Loan Repayment

Loan repayment refers to reimbursements of loans acquired by farms or individual farmers to finance various farm operations or purchase of capital goods. It is expected that a profitable farming will facilitate an effective loan repayment among farmers. The FSP-M model can as well be utilized to assess the correlation between loan repayment rate and profitability of a single farming system or comparing two or more farm systems.

5.8 Summary of Contributions to Knowledge and Understanding

The following is a list of contributions to knowledge and understandings made by this thesis:

i. Provides an empirical insight on the effectiveness of BFS as compared to TFS on profitability and loan repayment of the smallholder sugarcane farmers in Tanzania. BFS has been found to be 17% more profitable than TFS. Also BFS, with a repayment rate of 0.96, implies a low loan repayment delinquency (about 4%) as compared to a loan repayment delinquency/default of about 24% through TFS with a repayment rate of 0.76.

ii. Provides a theoretical argument that farming systems based on the network coordination theory (cooperative and corporate coordination, (Rehber, 2006), are more effective on profit maximization than those based on hierarchies' coordination theory (full ownership integration).

iii. Recommends a review and amendment of the Tanzania Agriculture and Livestock Policy to emphasise on joint farming systems like BFS.

iv. Recommends enactment of Tanzania Loan Act (TALA) and introduction of Tanzania Farmers Service Agency (TFSA).

v. Developed a new generic model, Farm Systems Profitability Model (FSP-M), and recommends it for future studies of profitability and loan repayment of farming systems.

0000000105.9 Further Studies on Profitability of Smallholder Farming Systems

The following further studies are recommended:

i. A study to assess how sucrose is measured and how it is related to the determination and setting of sugarcane prices is recommended following the unexpected result on the effect of sucrose content on the profitability of the smallholder sugarcane farmers. The study should also focus on how and to what extent the current procedure has affected the profitability of the smallholder sugarcane farmers.

ii. It is also suggested that studies to assess factors affecting loan repayment rate of smallholder farmers should be conducted. Factors of interest should include, but not limited to, interest rate, loan size, loan repayment duration, loan transaction cost, farm size, farming systems and institutional factors.

iii. A comparative analysis of institutional effects of microfinance institutions on loan repayment performance of smallholder farmers as well as of smallholder traders is also suggested.

5.10 Summary Conclusion

Despite of its short period in practice in Tanzania, Block Farming System which was introduced for the first time in 2006 has proved to be more effective than the Traditional Farming System practiced by majority of smallholder sugarcane farmers

(> 95%) into ensuring higher profitability. Farmers practising BFS had achieved a profitability of 0.56 as compared to a profitability of 0.39 realized by those practicing TFS. The profitability was measured as a ratio of the operating income (EBIT) to the total revenue and was assessed for a period from 2008 to 2012. The profitability realized through BFS is significantly higher by 17% as compared to TFS. The higher profitability of BFS has also resulted into higher loan repayment rate of 0.96 as compared to a loan repayment rate of 0.76 (20% difference) achieved through TFS. The thesis has also come out with various contributions (empirical, theoretical, policy and a generic Farm System Profitability Model (FSP-M).

REFERENCES

Acquah, H. & Addo, J. (2011). Determinants of Loan Repayment Performance of Fishermen: Empirical Evidence from Ghana. *Cercetary Agronomice in Moldova*, *XLIV*(Issue no.4(148)/2011).

Adegbite, D. (2009). Repayment Performance of Beneficiaries of Ogun State Agricultural and Multi - Purpose Credit Agency (Osamca) in Ogun State, Nigeria (2004 - 2007). *Am. Eurasian J. Sustain. Agric., 3(1)*, 117 - 125.

Amemiya, T. (1979). The estimation of a Simultaneous-Equation Tobit Model. *International Economic Review*, *20*(No. 1), 169 - 181.

Amemiya, T. (1985). *Advanced Econometrics.* Great Britain: T.J. Press padstow Ltd.

Arnold, G. (2008). *Corporate Financial Management* (fourth ed.). Essex, England: Prentice Hall.

Ayanda, I. & Ogunsekan, O. (2012). Farmers Perception of Repayment of Loans Obtained from Bank of Agriculture, Ogun State, Nigeria. *Journal of Agriculture Science, Volume 3*(no.1), 21-27.

Basimwaki, S. (2007). *Draft Report on Component B Block Farming in Tanzania.* Unpublished.

Bowman, W. (2011). Financial capacity and sustainability of ordinary nonprofits. *Nonprofits management and leadership, 20*(11), 55-65.

Carbaugh, R. (2006). *Contemporary economics:an applications approach.* Washington: Thomson/ South-Western.

Collins, H. (2011). *Creative Research: A Theory and Practice of Research for Creative Industries.* Laussane: AVA Publications.

Crowther, D. & Lancaster, G. (2008). *Research Methods: a Consice Introduction to Research in Management and Business Consultancy.* Oxford: Butterworth - Heinemann.

Directorate General for Agricultural. (2000). *Economic impacts of genetically modified crops on Agri-Food sector.* Bruxelles: European Commission.

Dixon, J , Gulliver, A. & Gibbon, D. (2001). *Farming Systems and Poverty: Improving Farmers' Livelihoods in a Changing World.* Rome: FAO and World Bank.

Dlamini, M. & Masuku, M. (2013). Profitability of Smallholder Sugarcane Farming in Swaziland: The Case of Komati Downstream Development Programme (KDDP) Sugar Farmers' Associations, 2005 -2011. *Sustainable Agriculture Research, Volume 2*(No. 1).

Dwivedi, D. (2008). *Microeconomics Theory & Applications.* Delhi: Dorling Kindersley (India) Pvt. Lttd.

European Commission. (2006). *Tanzania - EC Multi - Annual Adaptation Strategy for the Period from 2006 - 2013 Under the Accompanying Measures for Sugar Protocal Countries* . European Commmission.

Faul, F., Erdfelder, E., Buchner, A. & Lang, A. (2009). Statistical Power Analysis Using G*Power 3.1: Test for Correlation and Regression Analysis. *Behaviour Research Methods, 41*(4), 1149-1160.

freedictionary. (2013). *freedictionary*. Retrieved February 17, 2013, from http://www.freedictionary.com

Greene, W. (2000). *Econometric Analysis. Fourth Edition.* New York: Prentice Hall International Inc .

Harper, D. (2011). *Etymology Online*. Retrieved 2015, from Online Etymology Dictionary: http://www.etymonline.com

Hazlitt, H. (2013). *"The Function of Profits". Economics in One Lesson.* Ludwig Von Mises Institute.

Higgins, J. (2004). *Introduction to Nonparametric Statistics.* CA: Brooks/Cole-Thomson.

Hofstrand, D. (2013). *Understanding Profitability.* Retrieved June 10, 2015, from Iowa State University - Extension Outreach: http://www.extension.iastate.edu/adgm/wholefarm/html

Horngren, C., Harrison Jr. W. & Oliver, M. (2009). *Accounting* (8th ed.). New jersey: Prentice Hall.

Investopedia. (2011, June 11). *A Look at Corporate Profit Margins*. Retrieved May 1, 2013, from Investopedia website: http//www.investopedia.com

Jackson, J. & Mc Connel, C. R. (1980). *Economics (Australian edition).* Sydney: MIT Press.

Ken, M & Paulson, N. (2011). *Profitability and farm size on grain farms in Illnois.* Illnois: College of agricultural, consummer and environmental sciences, universty of Illnois.

Khijjah, R. (2004). *Presentantion on the Role of Government in Building Sustainable Rural Financial Market.* Arusha: Ministry of Finance. URT.

Kohn, M. (2005). *Financial Institutions and Markets* (12th ed.). New Delhi: Tata McGraw-Hill.

Koopahi, M., & Bakhshi, M. (2002). Factors Affecting Agricultural Credit Repayment Performance: Case Study in Birjand District. *Iranian Journal of Agricultural Sciences, 33,1.*, 11 -19.

Kothari, C. (2004). *Research Methodology: Methods and Techniques. Second Edition.* New Delhi: New Age International (P) Ltd.

Kuga, K. (2001). *The Non-Substitution Theorem: Multiple Primary Factors and the Cost Function Approach.* Osaka: The Institute of Social and Economic Research, Osaka University.

Lighton, D., Guveya, E., Bandason, W. & Mashapa, C. (2014). Socioeconomic Determinants of Smallholder Out-Grower Tea (Camellia Sinensis) Farming Profitability in Chipinge District, Zimbabwe. *Journal of Agriculture Economics and Rural Development*.

Logsdon, G. (2000). *Living at Natures Pace: Farming and the American Dream.* New York: Chelsea Green Publishing.

Long, J. (1997). *Regression Models for Categorical and Limited Dependent Variables.* Thousands OAKs, CA: Sage Publications.

Luhmann, N. (1995). *Social Systems.* England: Stanford University Press.

Madalla, G. (1992). *Introduction to Econometrics. Second Edition.* New York: Macmillan Publishing Company.

Madan, G. (1990). *India's Developing Villages.* New Delhi: Allied Publishers.

Madan, G. (1998). *India of Tomorrow* (Third revised and enlarged edition. ed.). New Delhi: Allied Publisher.

Madan, G. (2007). *Co-operative Movement in India* (Second Revised Edition. ed.). New Delhi: A Mittal Publication.

Magali, J. (2013). Factors affecting Credit Default Risks for Rural Savings and Credits Cooperative Societes (SACCOS) in Tanzania. *European Journal of Business and Management, Vol. 5*(No. 32).

Magambo, T. (2008). *Self Management of Block Farming of Kilombero Sugar Company Outgrowers.* Unpublished.

Mallows, C. & Tukey, J. (1982). An overview of techniques of data analysis, emphasizing its exploratory aspects. (pp. 111-172). London: Academic Press.

Malonga, M., Rugaimukamu, J. & Sheiza, J. (2009). *Technical Assistance to Facilitate Sensitization Training for Establishment of Block Farming to Outgrowers Association Management in Five Atreas of Kilombero, Ruembe, Mtibwa, Kagera and Zanzibar.* Unpublished.

Masuku, M. (2011). Determinant of Sugarcane Profitability: The case of Smallholder Growers in Swaziland. *Asian Journal of Agricultural Sciences, 3(3)*, 210 - 214.

Mbuyazwe, D. & Barnabas, D. (2012). Explanatory Variables Associated with the Yield Performance Gap among Small-Medium-and Large-Scale Sugarcane (Saccharum officinarum) Growers at Ubombo Sugar, Big bend, Swaziland. *Asian Journal of Agricultural sciences., Vol.4*(Issue1), 32-39.

McDonald, J. & Moffit, R. (1980). The Use of Tobit analysis. *Review of Econometrics and Statistics , Vol 62*, 318 - 321.

Murphy, R. (2011, May 23). Problems with the Cost Theory of Value. *Austrian Economics, Freedom and Peace.* Mises Institute.

Mushi, A. (2012). *Performance of Block Farming on Sugarcane Production from 2007 to 2011 - A Case of Kilombero.* Dissertation Submitted for the Partial Fulfillment of the Degree of Master of Business Administration of the Open University of Tanzania.

Nemes, N. (2009). *Comparative Analysis of Organic and Non-Organic Farming Systems: A critical Assessment of Farm Profitability.* Rome: Food and Agricultural Organization of the United Nations.

Ngaruko, D. (2010). Transaction Cost and their Implication on Agrocredit Supply Arrangements in Western Tanzania. *Huria Journal of the Open University of Tanzania*, 1-28.

Noe, E. & Alroe, H. (2012). Farm Enterprises as Self Organizing Systems: A new Transdisciplinary Framework for Studying Farm Enterprises'. *International Journal of Sociology of Agriculture and Food.*

Oni, O., Oladele, O. & Oyewole, I. (2005). Analysis of Factors Influencing Loan Default among Poultry Farmers in Ogun State Nigeria. *Journal of Central European Agriculture, 6*(no.4), 619 - 624.

Rasmussen, J. & Dunlap, W. (1991). Dealing with nonnormal data: Parametric analysis of transformed data vs nonparametric analysis. *Educational & Psychological Measurement, 51*, 809-820.

Rehber, E. (2006). *Contract Farming: Theory and Practice.* Turkey: Uludag University.

Rosett, R. & Nelson, F. (1975). Estimation of the Two - limit Probit Regression Model. *Econometrica, 43*, 141 - 146.

Roussakis, E. (1997). *Commercial Banking in Era of Deregulation.* Miami: Praeger.

Rugaimukamu, J., Mongi, J., & Baddeley, M. (2007). *Establishment of Block Farming in Outgrower Areas in Kilombero Valley.* Unpublished.

Rutgers. (2011). *Farm L United States department of agriculture farm services Agency -Farm loans fact sheet.* Retrieved May 2013, from aesop.rutgers.edu/farmmgmt: http:www.aesop.rutgers.edu

SAGCOT. (2014). *Concept Note: Southern Agricultural Growth Corridor of Tanzania.* Retrieved June 27, 2015, from AgDevCo: http//www.agdevco.com

Saunders, M., Lewis, P. & Thornhill, A. (2012). *Research Methods for Business Students* (sixth edition ed.). Harlow: Pearson education Limited.

SBT. (2010). *Organisational Structure of Outgrowers.* Retrieved January 2012, from Sugar Board of Tanzania.: www.sbt.go.tz

Shen, H. & Ziderman, A. (2008). Students Loans Repayment and Recovery: International Comparison. *Discussion Paper No.3588*. Bonn: IZA.

Sileshi, M., Nyikal, R. & Wangia, S. (2012). Factors Affecting Loan Repayment Performance of Smallholder Farmers in East Hararghe, Ethiopia'. *Journal of developing Countries Studies., 2*(No. 12).

Smith, D. & Brame, R. (2003). Tobit Models in Social Science Research. *Sociological Methods and Research. 31*, 364 - 388.

Tham, K. , Fox, Mark S. & Gruninger, M. (1994). *A Cost Ontology for Enterprise Modelling.* Toronto: University of Toronto.

Tham, K. & Fox, M. (2004). Determining Requirements and Specifications of Enterprise Information Systems on Profitability.Proceedings of the 6th International Conference on the Enterprise Information Systems. *International Conference on Enterprise Information System.* Toronto.

Tobin, J. (1958). Estimation of Relationship for Limited Dependent Variables. *Econometrica. 26(1)*, 24 - 36.

URT (United Republic of Tanzania). (2007). Morogoro Region Social Economic Profile. National Bureau of Statistics.

URT. (1997). *Agricultural and Livestock Policy.* Dar Es Salaam: Ministry of Agriculture and Cooperatives.

URT. (2000). *National Microfinance Policy*. Dar Es Salaam: Government Printer.

URT. (2007). Agricultural Sector Development Program. Dar Es Salaam, Tanzania: Ministry of Agriculture and Food Security.

Victor, D. (2012). Determinant of Loan Repayment Default Among Farmers in Ghana. *Journal of Development and Agricultural Economics. vol. 4(13) availlable online at http://www.academicjournal.org/JDAE*, 339 -345.

Waswa, F., Mcharo, M., & Gwei, J. (2011). *Contract Sugarcane Farming and Farmers' Incomes in the Lake Victoria Basin, Kenya*. Published online at www.m.elewa.org.

APENDICES

APPENDIX 1: QUESTIONNAIRES

A: Sugarcane Farmers Questionnaire

Dear respondent, this questionnaire is for a study on the profitability of smallholder sugarcane farming systems in Tanzania. The studies want to conduct a comparative analysis between Block Farming and Traditional Farming systems. The information you provide will only be used for the purpose of this research.

Please answer all the following questions to the best of your knowledge by putting a tick or fill as appropriate.

Section one:

1. Where is your farm located?

(a)Kilombero 1 (K1) [ ]; (b) Kilombero 2 (K2) [ ]

2. What is the size of your sugarcane farm?

1- 2 acres [ ]; 3 – 5 acres [ ]; 6 - 8 acres [ ]; 8 – 10 [ ]; 11 – 15 [ ]; 16 -20 acres [ ]; 21 – 30 acres [ ]; 31 – 40 acres, 41 - 50 acres [ ]; above 50 acres [ ]

3. Which type of a farming system are you practicing?

(a) Traditional/Individual farming [ ]; (b) Block Farming [ ]; (c) Both Block Farming and Traditional Farming [ ]

4. What is your gender?

(a) Male [ ]; (b) Female [ ]

5. What is your age?

(A) 18 - 35 years [ ]; (b) 36 – 49 years [ ]; (c) 50 - 60 years [ ]; > 60 years [ ]

6. What is your level of education?

(a) Primary education [ ]; (b) Secondary education [ ]; ((c) Post-secondary/college education [ ]; (d) university education [ ]

7. Please fill the Table below to the best of your knowledge:

Year	Area(acres) of farm harvested	Amount of sugarcane harvested	Sucrose content obtained	Price per ton	Gross revenue	Total Deduction
2008						
2009						
2010						
2011						
2012						

8. What was the total costs you incurred in your farm from land preparation up to when your sugarcane was harvested:

	SUGARCANE FARMING COST (in ,000) (PUT TICK)							
Year	300 - 500	550 – 750	800 - 1,000	1,250 - 1,500	1,550 - 1,750	1,800 - 2,500	2,550 - 5,000	Above 5,000
2008								
2009								
2010								
2011								
2012								

9. What was the amount of money you remained with after deducting all the costs from the sales of your sugarcane?

	SUGARCANE FARMING NET INCOME (amount in ,000) (PUT TICK)							
Year	300 to 500	550 to 750	800 to 1,000	1,250 to 1,500	1,550 to 1,750	1,800, to 2,500	2,550 to 5,000	Above 5,000
2008								
2009								
2010								
2011								
2012								

SECTION TWO

1. Have you ever taken a loan for your sugarcane farming from banks or SACCOs? Yes [ ]; No [ ]

2. If the answer to question no. 1 is yes, please fill the Table below

	AMOUNT BORROWED FROM BANKS/SACCOS IN SHILINGS (amount in ,000) (PUT TICK)							
Year	200 to 500	501 to 800	801to 1,000	1,001 to 1,500	1,501 to 2,000	2,001 to 2,500	2,501 to 3,000	Above 3,000
2008								
2009								
2010								
2011								
2012								

3. How many formal loans from banks and SACCOS did you take during the same period indicated above? (a) one loan [ ] ; (b) two loans [ ]; (c) more than two loans [ ]

4. Did you also take other informal loan ("mikopo ya riba") during the same period? (a) Yes [ ]; (b) No [ ]

5. Did you use a portion of the loan for other activities besides sugarcane farming? (a) Yes [ ]; (b) No [ ]

6. If the answer to question 5 is yes, please fill the Table below:

	AMOUNT (IN ,000 SHILLINGS) FOR OTHER ACTIVITIES NOT RELATING TO SUGARCANE FARMING (PUT TICK)							
Year	100 to 300	301 to 500	501 to 800	801to 1,000	1,001 to 1,500	1,501 to 2,000	2,001 to 3,000	Above 3,000
2008								
2009								
2010								
2011								
2012								

7. What was the status of your loan repayment to banks and SACCOS?

(a) I repaid my loans timely [ ]

(b) I delayed the repayment of my loans [ ]

(c) I only managed to repay a portion of my loans [ ]

(d) I failed completely to repay my loans [ ]

B: Financial Intermediaries Questionnaire

Dear respondent, this questionnaire is for a study on the profitability of smallholder sugarcane farming systems in Tanzania through comparative analysis between Block Farming and Traditional Farming systems. The information you provide will only be used for the purpose of this research.

Name of Bank/ Microfinance Institution: ………………..…………………………..

Location of the Bank/ Microfinance Institution: ……………………………………

Title of Responding officer: ………………………………………………………….

1. Is your organization extending loans to smallholder sugarcane farmers?

   Yes [ ]; No [ ]

2. If the answer to question 1 is yes, what is the rate of loan repayment by the smallholder sugarcane farmer?

(a) Less than 20% [ ]

(b) 20 – 40% [ ]

(c) 41% - 50% [ ]

(d) 51% -70% [ ]

(e) 71% -80% [ ]

(f) 81% -90% [ ]

(g) 91% -100% [ ]

3. What is the percentage of loan recipients who are delaying their loan repayment?

(a) Less than 20% [ ]

(b) 20% – 49% [ ]

(c) 50% - 70% [ ]

(d) 70% - 80% [ ]

(e) Above 80% [ ]

APPENDIX 2: STATA SE10 OUTPUT TABLES

File: C Users\user\Desktop\RESEARCHREPORT (PhD) 2013_15\ALLYMUSHIPhDTHESIS\PROFITABILITY OF SMALLHOLDER SUGARCANE FARMING SYSTEMS IN TANZANIA- a COMPARATIVE ANALYSIS BETWEEN BLOCK FARMING AND TRADITIONAL FARMING IN MOROGORO.dta saved.

Table A.1 : Location of respondents

			.Tab location, gen (location)
Location	Freq.	Percent	Cum.
K1	237	60.15	60.15
K2	157	39.85	100.00
Total	394	100.00	

Table A.2: Sex of respondents

			.tab sex, gen (sex)
Sex	Freq.	Percent	Cum.
Female	145	36.80	36.80
Male	237	60.15	96.95
Mixed	12	3.05	
Total	394	100.00	

Table A.3: Age of respondents

			.tab age, gen (age)
Age	Freq.	Percent	Cum.
18 - 35	185	46.95	46.95
36 - 49	131	33.25	80.20
50 - 60	54	13.71	93.91
>60	12	3.05	93.91
Total	394	100.00	

Table A.4: Education level of respondents

		. Tab education,	gen (education)
Education	Freq.	Percent	Cum.
College	12	3.05	3.05
Higher diploma	4	1.02	4.06
Illiterate	35	8.88	12.94
Primary	255	64.72	77.66
Secondary	72	18.27	95.94
University degree	4	1.02	96.95
Various	12	3.05	100.00
Total	394	100.00	

Table A.5: Observations by farming systems

. Tab farming_system, gen (farming_system)

Farming_system	Freq.	Percent	Cum.
Block Farming	35	3.37	3.37
Traditional Farming	1,005	96.63	100.00
Total	1,040	100.00	

Table A.6: t-Test Land size

. Ttest land sizeharecprsqrt, by (farming_system) unequal welch

Two-sample t test with unequal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	interval]
Block Fa	35	0.204	0.001598	0.009456	0.200752	0.207248
Traditio	1005	0.965542	0.011399	0.361398	0.943172	0.987913
Combined	1040	0.939914	0.011811	0.380908	0.916737	0.963091
Diff		-0.761542	0.011511		-0.784131	-0.738954

Diff = mean (Block Fa – Traditio) t = -66.1552

Ho: diff = 0 Welch's degree of freedom = 1032.77

Ha: diff < 0	Ha: diff! = 0	Ha: diff > 0
Pr(T<t) = 0.0000	Pr(|T|>t) = 0.0000	Pr(T>t) = 1.0000

Table A.7: One way ANOVA - land size

. Oneway land sizeharecprsqrt farming_system, bonferroni

Analysis of Variance

Source	SS	df	MS	F	Prob>F
Between groups	19.615023	1	19.6150234	155.26	0.0000
Within groups	131.13408	1038	0.126333		
Total	150.79910	1039	0.145091		
Bartlett's test for equal variances		Chi2(1)	211.1306	Prob>chi2	0.0000

Comparison of land size(ha) (recprsqrt) by farming_system, bonferroni

Col mean	Row mean Block Fa
Traditio	0.7615 0.000

Table A.8: t-Test – yield

. Ttest yieldhasqrt, by (farming_system) unequal welch

Two-sample t test with unequal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. interval]	
Block Fa	35	7.504514	0.105785	0.625831	7.289534	7.719495
Traditio	1005	7.412579	0.028637	0.907826	7.356385	7.468773
Combined	1040	7.415673	0.027899	0.899709	7.360929	7.470418
Diff		-0.091935	0.109592		-0.129653	0.313524

Diff = mean	(Block Fa – Traditio)	t = 0.8389
Ho: diff = 0		Welch’s degree of freedom = 1032.77
Ha: diff < 0	Ha: diff! = 0	Ha: diff > 0
Pr(T<t) = 0.7967	Pr(|T|>t) = 0.4066	Pr(T>t) = 0.2033

Table A.9: One-way ANOVA – yield

. Oneway yieldhasqrt farming_system, bonferroni

Analysis of Variance

Source	SS	df	MS	F	Prob>F
Between groups	0.285867	1	0.285867	0.35	0.5526
Within groups	840.761381	1038	0.809982		
Total	841.047248	1039	0.809477		
Bartlett's test for equal variances		Chi2(1)	7.2261	Prob>chi2	0.007

Comparison of yieldhasqrt by farming_system, bonferroni

Col mean	Row mean Block Fa
Traditio	-0.091935 0.553

Table A.10: t-Test – sucrose

. Ttest sucrosesqr, by (farming_system) unequal welch

Two-sample t test with unequal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. interval]	
Block Fa	35	101.59940	2.871006	16.98510	95.76484	107.434
Traditio	1005	97.05597	0.673009	21.33554	95.73531	98.37663
Combined	1040	97.20888	0.657782	21.21282	95.91514	98.49961
Diff		4.543459	2.948833		-1.425829	10.51275

Diff = mean	(Block Fa – Traditio)	t = 1.5408
Ho: diff = 0		Welch’s degree of freedom = 138.0608
Ha: diff < 0	Ha: diff! = 0	Ha: diff > 0
Pr(T<t) = 0.9342	Pr(|T|>t) = 0.1316	Pr(T>t) = 0.0658

Table A.11: On way ANOVA - sucrose

. Oneway sucrosesqr farming_system, bonferroni

Analysis of Variance

Source	SS	df	MS	F	Prob>F
Between groups	698.190495	1	698.190495	1.55	0.2131
Within groups	466834.727	1038	449.744438		
Total	467532.917	1039	449.983558		
Bartlett's test for equal variances		Chi2(1)	2.9504	Prob>chi2	0.086

Comparison of sucrosesqr by farming_system, bonferroni

Col mean	Row mean Block Fa
Traditio	-4.54346
	0.213

Table A.12: t-Test - price

. Ttest pricelog, by (farming_system) unequal welch

Two-sample t test with unequal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	interval]
Block Fa	35	11.01571	0.021659	0.128138	10.9717	11.05973
Traditio	1005	10.74803	0.008795	0.2788309	10.73077	10.76529
Combined	1040	10.75704	0.008660	0.2792804	10.74005	10.77403
Diff		2.2676843	0.023377		0.2206507	0.314718

Diff = mean	(Block Fa – Traditio)	t = 11.4508
Ho: diff = 0		Welch’s degree of freedom = 46.8045
Ha: diff < 0	Ha: diff! = 0	Ha: diff > 0
Pr(T<t) = 1.0000	Pr(|T|>t) = 0.0000	Pr(T>t) = 0.0000

Table A.13: One-way ANOVA – price

. Oneway pricelog farming_system, bonferroni

Analysis of Variance

Source	SS	df	MS	F	Prob>F
Between groups	2.423519	1	0.285867	0.35	0.5526
Within groups	78.615943	1038	0.075738		
Total	81.03946	1039	0.077998		
Bartlett's test for equal variances		Chi2(1)	25.4480	Prob>chi2	0.000

Comparison of pricelog by farming_system, bonferroni

Col mean	Row mean Block Fa
Traditio	-0.267684
	0.000

Table A.14: t-Test – costha

. Ttest costhalog, by (farming_system) unequal welch

Two-sample t test with unequal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. interval]	
Block Fa	35	14.12829	0.079227	0.468712	13.96728	14.28929
Traditio	1005	14.16193	0.014533	0.460713	14.13276	14.19045
Combined	1040	14.16080	0.014289	0.460795	14.13276	14.18884
Diff		-0.033645	0.080549		-0.196933	1296438

Diff = mean	(Block Fa – Traditio)	t = -0.4177
Ho: diff = 0		Welch's degree of freedom = 36.4618
Ha: diff < 0	Ha: diff! = 0	Ha: diff > 0
Pr(T<t) = 0.3393	Pr(|T|>t) = 0.6786	Pr(T>t) = 0.6607

Table A.15: One-way ANOVA - costha

. Oneway costhalog farming_system, bonferroni

Analysis of Variance

Source	SS	df	MS	F	Prob>F
Between groups	0.038285	1	0.382853	0.18	0.6713
Within groups	220.574956	1038	0.212499		
Total	220.613241	1039	0.212332		
Bartlett's test for equal variances		Chi2(1)	25.4480	Prob>chi2	0.889

Comparison of costhalog by farming_system, bonferroni

	Row mean
Col mean	Block Fa
Traditio	0.033645
	0.671

Table A.16: t-Test- profitability

. Ttest profitability, by (farming_system) unequal welch

Two-sample t test with unequal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. interval]	
Block Fa	35	0.555143	0.037795	0.223599	0.478334	0.631952
Traditio	1005	0.392398	0.007086	0.224629	0.378494	0.406303
Combined	1040	0.392398	0.007020	0.226399	0.384099	0.411651
Diff		0.162745	0.038454		0.084799	0.240689

Diff = mean	(Block Fa – Traditio)	t = 4.2322
Ho: diff = 0		Welch's degree of freedom = 36.4618
Ha: diff < 0	Ha: diff! = 0	Ha: diff > 0
Pr(T<t) = 0.999	Pr(|T|>t) = 0.0001	Pr(T>t) = 0.0001

Table A.17: One-way ANOVA – profitability

. Oneway profitability farming_system, bonferroni

Analysis of Variance

Source	SS	df	MS	F	Prob>F
Between groups	0.895809	1	0.895809	17.76	0.0000
Within groups	52.359995	1038	0.050443		
Total	53.255804	1039	0.051527		
Bartlett's test for equal variances		Chi2(1)	0.0014	Prob>chi2	0.970

Comparison of profitability by farming_system, bonferroni

	Row mean
Col mean	Block Fa
Traditio	-0.162745
	0.000

Table A.18: Summary statistics- Block Farming

> farming_system = BLOCK FARMING

Variable	Obs	Mean	Std.Dev.	Min	Max
Land size	35	24.07343	1.797264	20.23	26.3
Yieldha	35	56.698	9.301018	36.47	76.21
Sucrose	35	10.04571	0.839003	8.57	11.57
Price	35	61274.6	7446.152	40359	70208
Costha	35	1507257	640876.7	342387.5	2911175
Profitabil~y	35	0.5555143	0.223599	-0.06	0.86

Table A.19: Summary statistics - Traditional Farming

> farming_system = BLOCK FARMING

Variable	Obs	Mean	Std.Dev.	Min	Max
Land size	1005	1.734687	1.580165	0.20	8.09
Yieldha	1005	55.76964	13.56113	17.88	133.44
Sucrose	1005	9.790597	1.09632	6.30	13.63
Price	1005	48283.67	12606.48	14274	81761.41
Costha	1005	1566727	721821.2	25985	4767294
Profitabil~y	1005	0.39239	0.2246292	-0.15	0.88

Table A.20: Tobit regression analysis- Block Farming

. by farming_system, sort : tobit profitability land sizeharecprsqrt yieldhasqrt

> sucrosesqr pricelog costhalog, ll(0) ul(.8) vce(robust)

-> farming_system = BLOCK FARMING

Tobit regression

Number of obs = 35

F(5, 30) = 201.38

Prob > F = 0.0000

Pseudo R^2 is 25.5124

Log pseudolikelihood = 65.8668

Model	β	SE	t	P>|t|	[95% Conf. Interval]	
Land size (sqrt)	- 0.138308	0.4698848	- 0.29	0.771	-1.097941	0 .821325
Yield (sqrt)	0.1709008	0.0142844	0.96	0.000	0.141728	0.200074
Sucrose (sqr)	- 0.0001423	0.0003857	- 0.37	0.000	-0.000930	0.000646
Price (log)	0.6163947	0.0537301	11.47	0.715	0.506663	0.726126
Cost (log)	- 0.5263025	0.0249881	- 21.06	0.000	-0.577335	- 0.475269
Constant	- 0.0311753	0.715745	- 0.04	0.966	-1.492923	- 1.430572
Sigma	0.0285081	0.0041694			0.019993	0.037023

Notes: Obs. summary: 2 left-censored observations 32 uncensored observations 1 right-censored observation at profitabil~y>=0.8.

Table A.21: Tobit regression analysis- Traditional Farming

. by farming_system, sort : tobit profitability land sizeharecprsqrt yieldhasqrt

> sucrosesqr pricelog costhalog, ll(0) ul(.8) vce(robust)

-> farming_system = TRADITIONAL FARMING

Tobit regression

Number of obs = 1005

F(5, 1000) = 1782.89

Prob > F = 0.0000

Pseudo R^2 is 21.7057

Log pseudolikelihood = 1465.4415

Model	β	SE	t	P>|t|	[95% Conf. Interval]	
Land size (sqrt)	- 0.010899	0.0044477	- 2.45	0.771	-0.019626	-0.002172
Yield (sqrt)	0.1491543	0.0024741	60.29	0.000	0.144299	0.154009
Sucrose (sqr)	- 0.0000507	0.0000758	- 0.67	0.000	-0.000199	0.000098
Price (log)	- 0.5531943	0.0078827	- 88.30	0.715	0.537726	0.568663
Cost (log)	0.9582515	0.0060744	14.46	0.000	-0.548299	0.524459
Constant	0.9582515	0.0662766	14.46	0.966	0.828194	1.088309
Sigma	0.0460413	0.0012115			0.043664	0.048419

Notes: Obs. summary: 61 left-censored observations 926 uncensored observations 18 right-censored observation at profitabil~y>=0.8

Table A.22: Loan repayment by farming systems

. Ttest loan_repayment, by (farming_system) unequal welch

Two-sample t test with unequal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	interval]
Block Fa	9	0.961111	0.016197	0.048591	0.92376	0.998462
Traditio	70	0.762143	0.031376	0.262512	0.699549	0.824737
Combined	79	0.784810	0.028739	0.255444	0.727594	0.842026
Diff		0.198968	0.088173		0.23394	0.374542

Diff = mean (Block Fa – Traditio) t = 2.2566

Ho: diff = 0 Welch's degree of freedom = 77

Ha: diff < 0	Ha: diff! = 0	Ha: diff > 0
Pr(T<t) = 0.9866	Pr(|T|>t) = 0.0269	Pr(T>t) = 0.0134